DOCUMENT RESUME

ED 339 832 CE 059 731

AUTHOR	Phelps, L. Allen, Ed.; Thurston, Paul W., Ed.
TITLE	Public-Private Sector Collaboration in Education: Implications for Research, Policy, and the Education of Professional Educators. Proceedings of the Annual Rupert N. Evans Symposium (10th, Urbana, Illinois, May 2-3, 1989).
INSTITUTION	Illinois Univ., Urbana. Dept. of Vocational and Technical Education.
SPONS AGENCY	Illinois State Board of Education, Springfield. Dept. of Adult, Vocational and Technical Education.; National Center for Research in Vocational Education, Berkeley, CA.
PUB DATE	89
NOTE	157p.
PUB TYPE	Collected Works - Conference Proceedings (021)
EDRS PRICE	MF01/PC07 Plus Postage.
DESCRIPTORS	Business Responsibility; Community Colleges; Continuing Education; Coordination; Corporate Support; Economic Development; *Educational Cooperation; Educational Improvement; Excellence in Education; *Job Training; *Labor Force Development; Postsecondary Education; Private Financial Support; Retraining; *School Business Relationship; School Support; Secondary Education; Skill Obsolescence; Teacher Certification; Teacher Education; *Technological Advancement; Technology Transfer

ABSTRACT

These proceedings contain 11 papers that examine several diverse collaborative efforts designed to improve education and training programs through substantive involvement of the private sector. Authors and titles are as follows: "Public-Private Sector Collaboration in Education: Implications for Research, Policy, and the Education of Professional Educators" (Paul Thurston, L. A. Phelps); "The Developing Work-Related Education and Training 'System': Partnerships and Customized Training" (W. N. Grubb); "Relfections on Customized Training" (Richard Hofstrand); "A Reaction to 'The Developing Vocational Education and Training System': Partnerships and Customized Training" (Tim Wentling); "Promoting Technology Transfer in Community College Programs: The Michigan Experience" (James Jacobs); "Corridor Partnership for Excellence in Education" (Gail Digate, Marsha Bollendorf); "The California Partnership Academies" (Keith Bush); "Corporate Collaboration as a Catalyst for Teacher Education Development" (Robert Maloy et al.); "University-Corporate Collaborative Relationships in Continuing Engineering Education" (Anne Colgan); "Education-Business Partnerships: A Principal's Perspective" (Irene Diedrich-Reilly); and "Public-Private Sector Collaboration: Elements, Issues, and Implications" (L.A. Phelps, Paul Thurston). (YLB)

IL89PD10

ED339832

Public-Private Sector Collaboration in Education

Department of
Vocational and
Technical Education

College of Education

University of Illinois
at Urbana-Champaign

Proceedings of
Tenth Annual
Rupert N. Evans Symposium
May 2-3, 1989

Editors

L. Allen Phelps
Paul W. Thurston

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Partial funding support for this Symposium was provided through projects with the Illinois State Board of Education/Department of Adult, Vocational and Technical Education, Springfield, Illinois, and the National Center for Research in Vocational Education, University of California, Berkeley.

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Public-Private Sector Collaboration in Education: Implications for Research, Policy and the Education of Professional Educators

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Sponsored by the
Department of Vocational and Technical Education
College of Education
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Public-Private Sector Collaboration in Education: Implications for Research, Policy and the Education of Professional Educators

The Tenth Rupert N. Evans Symposium on Vocational Education

An Introduction

PAUL W. THURSTON
L. ALLEN PHELPS

It is fitting that the topic of this Tenth Rupert N. Evans symposium should be public-private sector collaboration. Rupert Evans has spent his professional life involved in examining the collaboration of these two sectors. As a scholar Rupert has been attentive to workforce availability and employee preparedness over the span of several decades. As Dean of the College of Education at the University of Illinois from 1964 - 1969 Rupert oversaw the programs that prepared teachers, administrators and scholars. As consultant to state governments, the federal government and numerous foreign countries, Rupert has advised countless policymakers about the interrelationships of government, educational institutions and private companies to facilitate the availability of an educated, well prepared citizenry and work force.

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The current interest in this topic of public and private sector collaboration is stimulated by a number of economic and social pressures. With growing concerns about economic vitality in this highly competitive global economy, concerns about the quality of public schools and their ability to provide an adequately educated workforce, concerns about a changing student population and concerns about adequate funding, a wide array of new collaborative ventures have been launched. Occurring virtually at all levels of the educational system, these partnerships have focused on improving high schools, community college/postsecondary technical education programs, teacher education and continuing professional education.

Although designed to provide greater effectiveness in resolving particular social or economic problems, these collaborative ventures also have the effect of significantly reshaping the mission and operation of the public and private sectors involved. This trend toward increased collaboration is particularly evident in the vocational-technical education, continuing education, and human resource development arenas. Federal and state policy continues to call for greater cooperation among the major delivery systems for vocational education, postsecondary and higher education, job training, public aid/social services, and education and training in the private sector.

Although a variety of partnerships have been formed, little has been done to map conceptually this effort, to assess the effects and outcomes of these initiatives, or to examine the implications for teacher education, continuing professional education, educational research, or public policy at the federal and state levels. We need to better understand a number of questions about these partnerships:

1. To what extent have partnerships been successful in achieving their goals and desired outcomes? What factors influence the decisions of the collaborating institutions to sustain their involvement in the partnership? How and to what extent is the overall mission of the collaborating organizations influenced by their involvement in the partnership?

2. What lessons have been learned from the partnerships which can be generalized to other similar settings and institutions? What have been the major incentives and barriers in effecting the partnership? How have the barriers been overcome?

3. What are the implications of these collaborative endeavors for improving public policy regarding education and economic development?

4. What are the implications for research universities involved in providing teacher and administrator education and continuing professional education programs?

5. What issues and questions should be included in a research agenda which examines education-business collaboration over the next three to five years?

The papers presented at this Tenth Evans symposium do not answer all of these questions, but they do speak to them to varying degrees.

W. Norton Grubb reviews public-private sector partnerships for the purpose of enhancing economic development in the chapter entitled "The Developing Work-Related Education and Training System: Partnerships and Customized Training." Grubb notes that the partnership movement has occurred as an integral part of rapid elaboration of the nation's complex system of work related education and training programs. His principal thesis is that the formation of customized training programs, generally involving community colleges and industries, exemplifies the pros and cons of partnerships generally. A detailed discussion of the advantages and disadvantages of public subsidies for customized training and economic development initiatives precedes a review of the exemplary partnership programs recognized in the "Keeping America Working" awards of the American Association of Community and Junior Colleges. Grubb argues that existing economic development partnership efforts need to be more rigorously evaluated and that additional government-sponsored demonstrations and experiments are warranted. He concludes that the high interest in partnerships for linking the business and education communities to address economic issues bodes well for building the next generation of vocational programs.

Following this chapter, Richard Hofstrand remarks on Grubb's work in "Reflections on Customized Training." He emphasizes the distinction between training and education, and further defines collaboration and economic development, and asks about the long term effects of training on employees. Tim Wentling furthers the discussion, looking at customized training as a vehicle for economic development. Wentling elaborates on many of Grubb's ideas, and emphasizes the challenges posed by these issues.

James Jacobs, in his chapter "Promoting Technology Transfer in Community College Programs," describes Michigan's approach to this basic problem of keeping a work force current in this rapidly changing technological environment. American industry has searched for new strategies with which to deal with the resulting new challenges from increased international competition. New manufacturing technologies, especially computer based and informational technologies, have benefited American industry. These innovations present challenges to vocational education. Among these tasks are the development of customized training, and the training of basic skills as well as high skill levels at the workplace. In short, the workforce needs to be retrained to be flexible enough to adapt to changes on their jobs. Jacobs explains the impact of the new technologies and the ensuing challenges upon the delivery of vocational education in Michigan as evidenced by the formation of the Liaison Office at the Industrial Technology Institute. This not-for-profit research organization has served as a catalyst for change within Michigan community colleges' vocational education programs. The Liaison Office demonstrates a partnership between vocational education and industrial organizations formed to retrain manufacturing establishments to further the economic development priorities of the state.

Gail Digate and Marsha Bollendorf describe the Corridor Partnership for Excellence in Education, an active education-business partnership in the western suburbs of Chicago. Formed in 1984, the Corridor Partnership involves a large number of education and business leaders. The Partnership serves as a catalyst for bringing together business, education, research, government and labor leaders; and also serves as a broker for exchanging resources among these groups for the purpose of enriching mathematics and science instruction. To date, the Partnership has been successful in establishing the Illinois Mathematics and Science Academy, a summer research program for teachers, workshops for teams of elementary and middle school teachers, an innovative science fair competition, and an awards program for recognizing excellence in teaching. Digate and Bollendorf contend that education and business leaders at all levels need to collaborate for the purpose of creating a better prepared and more scientifically literate workforce for the 21st century. Their experiences suggest that educators and educational leaders need to be cognizant of the change process in organizations, as well as the processes for collaboration which can create shared meaning and mutual respect.

The chapter by Keith Bush describes the California Partnership Academies. It contains an historical overview of the seven year life of these partnership academies which have been implemented in 18 California high schools. With substantial state and corporate foundation funding, these academy partnerships have grown rapidly in the past several years. Bush's paper focuses on the development and management of the East Side Electronics Academy in San Jose. Evaluation studies documented numerous positive effects emerging from the Academy model for providing English, math and science instruction in conjunction with the academy's career theme (e.g. electronics, health careers, finance, etc). The major implications cited by Bush for teacher education include providing both current and future teachers with team-building skills and frequent opportunities to observe and shadow employees in technical and professional fields.

The paper by Maloy, LaLonde, and Clark, "Corporate Collaboration as a Catalyst," examines the Math English Science Technology Education Project (MESTEP), a fifth year certification and master's degree program at the University of Massachusetts-Amherst. The program is a collaboration between public school systems, high technology firms, and the University. Its goal is to expand the way in which new teachers think about work, technology, and teaching and learning in schools. MESTEP participants learn on campus as well as in alternate semesters in full-time paid teaching and corporate internships. The authors believe that MESTEP is a successful interorganizational endeavor because of its longevity as a partnership; its capacity to recruit, educate, place and retain talented students in teaching; and its ability to expand its original base of school and corporate support. MESTEP's collaborative planning and problem solving have helped redefine many elements of more traditional teacher education programs. They have provided new teachers with firsthand opportunities to experience changing jobs and emerging technologies. MESTEP also provides its teacher education students with a new understanding about teaching and learning.

The chapter by Anne Colgan, "University-Corporate Collaborative Relationships in Continuing Engineering Education," profiles the collaborative relationships between five research universities and nine corporations in establishing continuing engineering education programs. Three basic issues central to such collaboration between universities and businesses were addressed:

1) The organizational goals and objectives of both groups served by the collaboration.

2) The formal and informal administrative structures that support and impede the collaboration.

3) The incentives provided to individual members of the two groups to participate in the collaboration.

To understand the several collaborative continuing engineering education programs represented in the study, Colgan interviewed individuals within the school/college of engineering involved in the design and/or delivery of collaborative engineering education programs and corporate representatives knowledgeable about the decision and implementation of the continuing education programs. Her findings indicate that:

1) Fundamental societal changes and factors external to the universities and corporations were the driving forces behind these collaborative activities.

2) Collaboration both broadens and narrows the definition of continuing professional education among the universities and corporations in the study.

3) Collaboration involves a complex network of decisions, interpersonal relationships, and activities.

In a summary response to several of the papers, Irene Dietrich-Reilly provides a principal's perspective on education-business partnerships. She cites opportunities for personal growth, and stresses the importance of attention to details, and the value of entrepreneurial training.

In the last chapter we suggest that a conceptual framework for understanding these collaborative relationships is critically needed. To initiate the discussion of potential conceptual frameworks, we examine the central elements of successful collaborations as found in the literature and as extended by the Symposium papers. Finally, the implications that these collaborative relations hold for research and inquiry, leadership and professional education are explored.

We are deeply indebted to the Symposium presenters, reactors, and participants for a stimulating and thoughtful dialogue about the essence of public/private sector collaboration. Through this proceedings document, we have attempted to capture and transmit the rich perspectives of educators, policymakers, and business leaders on this important topic. Finally, we greatly appreciate the diligent efforts of Ms. Marsha Woodbury and Ms. Becky Taylor, who have carefully and cogently edited the volume.

The Developing Vocational Education and Training "System": Partnerships and Customized Training

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W. NORTON GRUBB

"Partnerships" — partnerships between business and the public sector — have become increasingly widespread during the 1980s. Their popularity seems to date from the early years of the Reagan administration, with the greater power and visibility of business as the country turned to the right. But there is another way to view these creations, particularly for those of us who are unhappy about the conservative drift of the past decade: Partnerships are in part an antidote to one of the least lovely aspects of American exceptionalism. American exceptionalism refers to the ways our country developed differently from our European progenitors, with a much more virulent form of individualism, a much more limited role for the state to play, and therefore a form of capitalism much less restrained by public influences. The result has always been a greater hostility between public and private sectors — a deeper distrust of business towards any kind of government involvement or regulation, and a much greater hostility of those in the public sector toward what the private sector is doing.

We can see this kind of hostility in the development of the vocational education system as well. As part of the movement for

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vocational education after 1900, a battle between capital and labor took place over who would control job training. From their side, many manufacturers — especially small- and medium-sized manufacturers — excoriated labor unions for controlling entry into skilled trades; in their support for vocational education in the public schools, they seemed much more interested in wresting control over training from the labor movement than they were in the content of vocational programs. Once the movement for vocational education in the schools was won, their enthusiasm for vocational education dissipated, replaced by indifference. From its side, labor complained about the efforts of business to squash unions, and castigated the first privately-owned vocational training schools as "scab hatcheries", breeding grounds for strike-breakers; labor feared that vocational education would help business control the training that had once been the responsibility of unions through apprenticeship programs. Labor was initially ambivalent about vocational education in the public schools, fearing that it would become a second-class education for working-class students, but they joined the movement for vocational education largely to have a say in its development, and to prevent business from having a monopoly over its direction (Lazerson and Grubb, 1974). The legacy of this historical development was a system of vocational education disconnected from employers, in which the public and the private sectors have viewed each other with distaste and distrust if not outright hostility, in which reformers have since had to work to restore some connection between education and employers.

We can now see much more clearly that the mutual distrust and hostility which are the consequences of exceptionalism are serious impediments: this approach doesn't develop good public policy or effective public programs, and many of our trading partners — including Japan and many European countries — provide us evidence that hostility between the public and private sector is detrimental to economic development as well. One way we can understand the new interest in collaboration, then, is as an antidote to the division between the public and private sectors, an attempt to replace hostility with closer relations between the public and private sector.

In the rest of this paper, I will first trace the elaboration of education and training programs over the past three decades, and then focus on a particular kind of partnership between employers and public education and training institutions — customized training. Customized training, which I define as training undertaken by a public institution for a particular employer, can take many different forms, but it always involves a close working relationship with a specific employer — or, more rarely, a group of employers — and therefore constitutes a partnership with a specific purpose. It differs from conventional vocational education in preparing students for a specific employer rather than preparing them for the labor market in general, though the extent of "customization" — or content developed for the particular employer — varies considerably; and customized training usually differs from other vocational programs in the particulars of duration, intensity, location, funding, and procedures for selecting students. Customized training exemplifies the pros and cons of partnerships generally, and given the evident increases in such arrangements it is important to scrutinize them carefully, to understand better both their potential and their possible liabilities.

The Development of the "System" of Work-Related Education and Training

The movement for partnerships comes as the "system" of work-related education and training is becoming increasingly complex. In fact, the development of partnerships and customized training in particular is itself part of the elaboration of education and training programs. Just three decades ago, work-related education and training was quite simple, and small in scope. High schools provided some vocational education, but there was relatively little of it — since perhaps one fifth of high school students were enrolled in any kind of vocational education — and was widely regarded as peripheral (Levitan and Mangum, 1969). Community colleges offered some vocational courses; but despite decades of efforts by some reformers to convert the community colleges into vocational institutions, almost all students were enrolled in transfer programs. A few states sponsored technical institutes, in place of or alongside community colleges, but no other public institutions provided vocational education and training. The only federal support came through the Smith-Hughes Act, which provided about $50 million for vocational education. Private vocational schools existed, of course, most of them in a few well-defined areas: cosmetology and barbering, secretarial and office training dominated.

In the past three decades the work-related education and training "system" has both expanded enormously and become institutionally complex. High schools still provide vocational education, but they have been joined by adult schools and area vocational schools, which cater both to secondary and post-secondary students; by community colleges, which became predominantly vocational institutions during their enormous expansion in the 1960s and 1970s; and by increasing numbers of technical institutes and colleges. Outside the educational system, programs funded by the federal Job Training Partnership Act (JTPA) provide shorter-term job training to various groups of disadvantaged and at-risk individuals, and states have established their own training programs, most of them linked to economic development. Another set of programs provides job training to welfare recipients, as part of the recent "welfare-to-work" initiatives. Many job training and welfare-related programs are provided by community-based organizations, trade unions, firms, and other institutions that received no public funds thirty years ago, adding to the variety of institutions providing training. Finally, private vocational schools have by all accounts expanded enormously, and have come into the public realm indirectly because of the substantial amounts of student aid they receive. Many hybrid institutions have developed, combining funds from different programs (and sometimes from private sources) to provide many different employment-related services to their clients. A complex "system" — in reality a non-system of many uncoordinated parts — has evolved in relatively short period of time.

There are at least three different reasons for the elaboration of work-related education and training. One is the process of institutional expansion: entrepreneurial institutions expand in any ways that they can. In many states there has been a process where the secondary-level area vocational schools established in the 1960's developed into technical institutes serving more adults, and then became community colleges with the addition of academic programs. Of course, community colleges expanded enormously in the 1960's and 1970's and moved dramatically into vocational education in the process of doing so (Brint and Karabel, 1989; Grubb, 1984). The increasing enrollments in private vocational training schools, especially with the availability of student aid, provide yet another example of institutional expansion. In the process we can see institutions taking on different roles as they seek to maximize their enrollments: area vocational schools became postsecondary institutions and even comprehensive community colleges, transfer-oriented community colleges became (in many cases) predominantly vocational institutions.

A second reason for the increasing complexity of this "system" is dissatisfaction with some of its components. The rise of manpower training programs in the 1960's, organized outside the public school system, was partly due to dissatisfaction with school-based vocational education; the legacies included the CETA (Comprehensive Employment and Training Act program of the 1970s and JTPA (the Job Training Partnership Act) programs of the 1980s, which provide a conception of work-related training quite different from that of most vocational education. Similarly, the welfare-related training programs which emerged in the 1960's, recently strengthened in JOBS (Job Opportunities and Basic Skills) program in the Family Support Act of 1988, reflect dissatisfaction with the way welfare recipients have been treated in both schools and in job training programs. Many of the innovations in the education and training "system" also reflect dissatisfaction with performance; for example, the development of performance standards and of Private Industry Councils (PICs), with a majority of employers, governing JTPA programs were efforts to improve the connections with employers and hold these programs to standards of accountability.

Yet another reason for the elaboration of the "system" of work-related education and training, partly related to dissatisfaction with existing programs, is the discovery of new needs, including groups of clients poorly served by the existing programs. Job training programs, starting with the manpower training programs of the 1960s and including JTPA, serve a group of individuals who are not likely to be in school-based programs; welfare-to-work programs similarly include individuals who would otherwise be left out of the "system". The most recent development along these lines has been the enactment of state-funded job training programs linked explicitly to economic development, where the "client" of the program is considered to be the employer rather than the individual trained (Grubb and McDonnell, 1989). The rationale for these new programs has in most cases included the need for economic development — itself a new goal for education and training institutions — along with the perception that existing programs, including vocational education, were not serving the interests of employers very well. Many of these programs have followed the lead of JTPA by requiring a governing board dominated by employers; several of them, including California's Employment Training Panel and the Bay State Skills Corporation in Massachusetts, created new mechanisms of delivering training because of the perceived inadequacies of existing institutions (though most of the programs operate through existing institutions, especially community colleges and public technical institutes). Almost all of these new programs support customized training — the provision of relatively firm-specific skill training for individual firms, a form of training which is more responsive to a firm's requirements than are general vocational programs. Thus publicly-funded customized training is both the most recent elaboration in the increasingly complex "system" of work-related education and training, providing a new view of what training should look like, and is a good example of an effort to use public programs to sponsor a particular type of partnership between employers and public education and training institutions.

Customized Training: Partnerships in the Service of Economic Development

In addition to capitalizing on the recent interest in partnerships, customized training has also drawn upon the sometimes desperate search for programs to enhance economic development. Institutionally, customized training is provided in a variety of different settings. Many community colleges, postsecondary technical institutes, and area vocational schools provide training to specific firms, using regular funds generated by enrollments as well as funds from federal sources including the Carl Perkins Act and the Job Training Partnership Act (JTPA). The JTPA program itself provides support for work experience programs and on-the-job training, sometimes through educational institutions but often through community-based organizations, unions, and firms. The recent amendments to JTPA, in the Omnibus Trade Bill of 1988, will (if funded) expand federal funding for displaced worker programs, and require that such programs be jointly devised with employers, strengthening the likelihood of firm-specific training. Finally, a number of states have devised their own training programs — like the Employment and Training Panel in California, and the Bay State Skills Corporation in Massachusetts — most of which provided firm-specific training. Some states (like Colorado) have had a specific policy forbidding state funds in educational institutions from being used for customized training, though most appear not to have formulated any specific policy.

The variety of public funding sources is matched by variety of the training programs themselves. Some operate with substantial subsidies from firms, or firm donations of equipment, materials, space, and even instructors, while others appear to depend wholly on public subsidies. Some take place on a firm's premises, while others are located on the campus of a postsecondary institution or in some third location. In some, the firm participates in choosing participants, while in others the institution providing the training recruits and selects the participants. Many customized programs operate with open entry/open exit schedules, though some also use the regularly-scheduled programs of their institutions, operating on a standard academic schedule. Most customized training programs appear to be of relatively short duration, however, certainly shorter than the period required for a certificate program or an Associate degree. Since there has not yet been a census of any kind, it is difficult to generalize about customized training; about the only certainty is that the number and variety of these programs has increased substantially over the past few years.

Customized training offers some obvious and powerful advantages to vocational institutions. One of the most important is the connection it provides to employers. A persistent criticism of vocational education is that it tends to become insulated from labor market developments, to rigidify into unvarying courses (like high school shop, clerical courses, and home economics) which ignore changes in employment and the skills required on the job. This accusation, most frequently leveled against high school programs, is also expressed by administrators in job training programs who complain that vocational education is too unresponsive to changing conditions, unwilling to vary the standard academic format of semesters, and insufficiently oriented to performance and placement. However, especially at the postsecondary level, the activity around customized training presents a very different image of these institutions: they appear flexible, responsive, creative in devising alternative formats for vocational courses, and willing to work with employers in customizing training rather than teaching courses in the same way to all students.

A second obvious advantage to customized training is that, where firms make contributions of equipment, they can help vocational programs keep up to date. Vocational programs all seem to have a hard time finding the funds to purchase equipment, especially in high-tech areas where equipment is expensive and changes rapidly; most states provide relatively little funding for equipment, and most fail to provide any cost differentials for the higher costs of certain vocational programs. While much of the program improvement funds of the Carl Perkins Act are used for equipment, the amounts of such funds in most states are quite insubstantial, amounting to between two percent and four percent of postsecondary vocational budgets (Grubb and Stern, 1989a). Therefore contributions of equipment or materials can be a real benefit to keeping vocational programs current.

Customized training also presents new opportunities for combining general and specific training. The balance between the two has always been an issue in vocational programs, but ways of integrating general or academic skills with more narrow, job-specific skills has been difficult to achieve, at least in vocational programs without a cooperative work component. But with customized training, students can enroll in general vocational courses and academic courses at the same time that they receive firm-specific training, in theory facilitating the integration of general and specific education. Whether many customized training programs take advantage of this opportunity is unclear; indeed, most of them appear to be too short, and too focused on the needs of firms, to pay much attention to such integration. But the opportunity to do so still exists.

Yet another advantage of customized training is that it provides an obvious placement mechanism. Community colleges have often been faulted for having weak placement efforts, and certainly they do not stress placement services to the same extent that welfare-to-work or JTPA programs, with their placement-oriented performance standards, do. But placement in customized training programs is almost certainly higher than in other vocational programs, providing obvious benefits to students and postsecondary institutions.

Finally, customized training may be socially efficient, as well as beneficial to firms and students. If there are economies of scale in training, then small and medium-size firms cannot provide their own training except at enormous cost per worker. Indeed, it appears that many of the firms who have participated in customized training programs are small and medium-size, turning to community colleges and technical institutes precisely because they are better organized to provide training, at lower costs for organization and overhead, than are firms.

The most obvious benefit of customized training — the benefit to the firm, in the form of lower training costs and improved productivity — isn't clear until we know the division of cost between the firm and the educational institution. If the firm pays the full cost of its specific training, then the advantage to the firm comes from the possible economies of scale, or perhaps from the greater joint productivity of specific training undertaken with general or academic education. If, on the other hand, the public sector pays for the majority of costs through its subsidies to community colleges and technical institutes, or through the recent state-funded job training programs, then the firm benefits from having its training expenses paid at public expense. Many programs of customized training justify their performance by evidence of decreased costs to firms, as if this were justification enough (Fadale and Winter, 1988; Office of the Legislative Analyst, 1986).

Customized training seems to have something for everyone, then: students get appropriate training and then are placed, presumably at higher rates than in conventional vocational programs; firms get part of their training costs subsidized; educational institutions increase their enrollments, enhance their services to their communities, and strengthen their connections to employers, and (we hope) communities benefit from economic development.

Nonetheless, there are potentially serious drawbacks to customized training. One way to clarify the potential limitations of customized training is to ask how it might be expected to further economic development. One answer, of course, is that by lowering training costs it might lure employment from other regions — the approach of "smokestack-chasing" which has often dominated economic development efforts in the past, but which has been generally discredited. Not only are there serious questions about whether relatively minor training subsidies can have much effect on the location of firms, this kind of "beggar-thy-neighbor" policy is indefensible, from a national perspective, except in special circumstances.[1] Indeed, customized training may operate to shift employment away from high unemployment areas: in California there are some indications that customized training programs in community colleges are helping to draw employment away from central cities and to suburban areas, exacerbating the problems of minority unemployment.[2]

There are three other relatively obvious objections to customized training. One involves its role in affirmative action, in gaining access to employment for minorities and access to non-traditional occupations for women. If the educational institution recruits and selects the individuals to be trained in a customized program, then we would expect there to be affirmative action policies in place; although they may not work as well as one would like, two-year colleges and technical institutes have been more committed to affirmative action than almost any other sector of education. If, on the other hand, the firm recruits and selects trainees, or selects trainees from its existing labor force, then any patterns of employment discrimination within the firm may show up in the customized training program as well. Evaluations of customized training programs therefore need to consider the composition of trainees, to ensure that existing policies designed to enhance the employment of minorities and women are not undermined. However, it is also important to recognize that where customized training is used for skills upgrading and retraining of existing workers who might otherwise be laid off, then there is no alternative to having the firm select the trainees, and the issue of potential bias in the composition of trainees may be intractable.

Yet another practical concern about customized training involves a long historical battle over vocational education. A persistent criticism is that vocational education tends to become overly narrow and occupation-specific, so that individuals trained are prone to become unemployed as production methods change and particular sectors decline (Grubb, 1979). The recent criticism from the business community of "narrow vocationalism" has been the most recent expression of this concern, which has generally led to efforts to broaden vocational programs and integrate them more firmly with academic components. The emphasis on flexibility in the labor force also argues for more general training.[3] But customized training — along with short-term JTPA programs and the job training programs sponsored by states — represents the contrary trend, in the direction of more specific and narrowly-defined training. This generates the question of whether customized training programs are in the *long-run* interests of employees and employers, or whether they simply serve to provide short-term training which is quickly made obsolete. If so, then their effects on wages and on economic development may be short-lived and illusory.

A third possibility is that customized training merely substitutes for the training which firms would otherwise provide themselves. For example, in an examination of customized training in New York, 34 percent of firms would have provided training in the absence of customized training, and another 45 percent would have purchased training elsewhere; only 20 percent reported that they would not have provided training (Fadale and Winter, 1988). This implies again that the customized program provided a simple subsidy to most firms, but no change in their training or in subsequent productivity.

These potential problems with customized training are relatively concrete, and — in principle at least — easy to evaluate. However, there are other less obvious problems with customized training that are also more difficult to evaluate. If customized training is promoted as a way of enhancing local employment rather than "smokestack chasing", then the appropriate question is how it might be expected to increase employment, and by how much. Based on a simple microeconomic analysis (Grubb and Stern, 1989b), the effects of any training program on the employment and wages of trainees depend crucially on the nature of demand, and efforts to use vocational education to enhance employment and production should target their efforts on specific occupations and sectors — particularly on those occupations where demand will increase substantially as wages fall, so that those trained are likely to increase employment rather than substituting for other workers. These conclusions apply to customized training just as much as they do to other forms of vocational education.

A special danger arises from the nature of customized training, which almost by definition prepares workers for positions requiring significant amounts of firm-specific training. In the presence of firm-specific skill requirements, demand for workers will be less sensitive to wages than in the case of workers not requiring specific training; furthermore, empirical estimates indicate that demand is particularly insensitive to wages for non-professional or non-managerial employees (Stern and Grubb, 1988). Thus the danger is that the types of occupations which are usually the targets of customized training programs may be those for which training is least effective as a way of increasing employment, and which increase employment only by reducing wages substantially.

This analysis points up another problem involved in the public subsidy of firm-specific training. Within economics, a convention has developed that firms should pay the costs of firm-specific training, since they reap the benefits; and that individuals, or government, should pay only for relatively general training (Becker, 1975). Firms have no incentive to pay for the general training of their employees, because their employees could then leave to receive higher wages elsewhere. Conversely, government subsidy of firm-specific training will be inefficient, since by lowering the costs of training it will induce firms to hire more workers than it otherwise would and will provide them too much specific training. However, government subsidy of specific training will increase both wages and employment more than the simple expansion of a vocational program in the absence of a specific training component would, precisely because it increases the demand for trained workers by the firm as well as increasing the supply of trained workers. (These conclusions are developed in Grubb and Stern, 1989b, and Stern and Grubb, 1988).

This creates a dilemma for public policy: Customized training is likely to have more positive effects on employment and earnings than do conventional education programs, and thus may be superior from the perspective of economic development; but *if* government subsidizes the entire cost of customized training then customized training constitutes a public subsidy of private training, a subsidy from taxpayers as a whole to firms and students, and its costs to government will outweigh its benefits to the individuals trained and to firms. This conclusion suggests that, because there have been strong political constituencies for economic development, and because of the growing notion that firms should be the primary "clients" of vocational education, there may be strong pressures for public subsidy of firm-specific training even when this may not be in the public interest.

Examining Some Customized Training Programs

There are, then, many potential benefits of customized training, but there are substantial dangers as well. One way to disentangle which of these predominate is to examine some customized training programs, to see whether or not they exploit the potential of customized training and avoid the pitfalls, and to examine the recent state-funded job training programs which often support customized training. In the absence of any "census" of customized training efforts, we have examined a group of programs which applied to the American Association of Community and Junior Colleges for its "Keeping America Working" awards, given annually for innovative cooperative efforts between community colleges and technical institutes and employers.[4] Admittedly these are not a random sample of cooperative efforts, but rather those which consider themselves good enough to vie for a national award; it is possible that they do not reflect the general patterns of customized training in this country. Still, they represent the efforts of some forward-looking educators and business people to develop partnerships, and there is probably more to be learned from them than from mediocre programs.

These various partnerships were initiated by firms in about half the cases, initiated by the educational institution in about one quarter of the cases, and jointly devised — often because of an ongoing history of collaboration — in the remaining quarter of cases. The process of initiation therefore seems to be a two-way street, with both firms and postsecondary institutions initiating [illegible]grams in different cases. Most of the time — in at least two-thirds of the cases — the "client" was an individual firm, but in about 10 percent of cases a group of firms constituted the client, while the remainder of arrangements involved either government agencies or groups of firms and government agencies.

In cases where the "client" was a single firm, about two-thirds of the firms involved were national and international companies, and only a third were purely local or regional firms. This finding suggests that customized training efforts have not concentrated on small- and medium-size firms of purely local or regional scope, but have instead worked extensively with larger firms. The implications for economic development are not clear, though the large number of programs with national firms may suggest a strategy of chasing after the branch plants of national firms — a variant of "smokestack chasing" — rather than helping local firms expand.

Most of the firms involved in customized training were engaged in manufacturing, in a striking diversity of sectors. The other common sector of economic activity included firms involved in transportation, including trucking firms, bus companies, and railroads. Very few of these projects involved service activities, retailing, wholesaling, or professional firms. The sectors involved in these customized training efforts seem to be consistent with targeting sectors likely to generate exports.

The vast majority of these partnerships — about 80 percent — focused on training, but a few provided assessment and counseling and others included the development of a training facility of resource center that the firms then operated on their own. For those that concentrated on training, about half relied exclusively on customized training; a very few relied exclusively on courses that the college or technical institute offered to the public at large, but most of the remaining half relied on a combination of customized training and existing courses. Of course, reliance on both existing courses and customized training provides special opportunities for combining general or "academic" preparation with firm-specific preparation, though it doesn't prove that integration in fact takes place. Almost all the training was directed at job-specific skills, though a very few of the partnerships included non-specific education including "workplace literacy" courses designed to improve basic skills and a few enrichment or refresher courses.

The location and provision of training also illustrates the variety of arrangements which have taken place. In about half the cases where location was identified, the training took place at the college; in another quarter the firm's facilities were used, and in the remaining quarter training took place at both the firm's facilities and the the college. In perhaps 60 percent of the partnerships the college provided all the instructors; in perhaps 10 percent instruction was evenly divided between college instructors and the firm's employees, and in the remaining cases the firm provided some assistance in providing trainers. The provision of equipment was similarly varied, with the college providing all materials in about half the cases; the firm and the college jointly provided materials in slightly over one-third of these programs, and the firm provided all materials in the remaining cases. Very roughly, then, in about half of these examples of customized training, the educational institution provided the location, instructors, and materials, but in the remaining half there were contributions of facilities, instructors, and materials by the firms involved, with "partnership" — a rough division of contributions — more common in these cases than contributions by the firm alone.

In about one third of the cases where the reason for collaboration could be identified, firms needed additional employees in particular occupations that were unavailable in the area, indicating that remedying skill shortages may be the most important purpose of customized training. Another quarter of cases required new skills because of technological change, and about one fifth provided retraining to existing workers to avoid potential layoffs, particularly in cases where firms changed the kind of production taking place in a local facility.

Obviously the interests of the firms involved was foremost in these projects, but in at least six of the forty-five partnerships examined the firm intended the training program to benefit particular groups with special employment needs including the handicapped, high school dropouts, and AFDC recipients. In these cases the training often focused on "employability skills", including assessment and training aimed at helping individuals to develop appropriate work-related attitudes and effective job-seeking skills and to identify their vocational interests and training needs. These particular partnerships appear to be JTPA programs (and perhaps welfare-to-work programs) which operate by placing individuals in firms for on-the-job training, creating a very different type of partnership than customized training represents.

The selection of individuals for training is often unclear. Where the method can be identified, the firms involved chose participants about half the time, the educational institutions chose participants in about one quarter of cases, and there was joint selection in the remaining cases. Of course, for those programs that involved retraining to prevent layoffs or skills upgrading to meet the requirements of new technologies — which represented about 45 percent of these programs examined — selection by the firm is all but unavoidable. While the potential problem of discrimination in customized training programs exists, then, it appears that the educational institutions play a role in selecting participants in most cases of entry-level training, and so possibilities for discrimination may not be especially serious.

The funding of these customized training programs is difficult to ascertain, and multiple funding sources exist in at least half of these efforts. However, the firms involved (or the firms and their labor unions) provided the major funding in about half these programs; the state provided major funding in one third of these cases, the college itself in slightly over ten percent of cases, and the Job Training Partnership Act in another fifth. In addition, at least some of these projects benefited from indirect government subsidies: several built training facilities with Industrial Development Bonds, which have lower interest rates because of their tax-free status and therefore involve federal and state subsidies. Most of these programs are supported by government resources in some way, therefore, though the relative balance of public and private funding remains unclear.

Another source of information about funding patterns comes from the state-funded job training programs that have been enacted recently, many of which provide resources for community colleges and technical institutes to provide customized training. In about one third of the states that have established job training programs related to economic development, there is a requirement that the firms match public contributions dollar for dollar, insuring that the state pays 50 percent or less of the total cost.[5] Thus there have been safeguards, at least in some states, to assure that firms cannot simply support private training at public expense. The sharing of costs is also a mechanism by which firms can pay for the specific aspects of training while the state pays for more general aspects and for the public benefits.

The most elusive aspects of the customized training programs we reviewed are their outcomes. Clearly there are many educational institutions and firms that are pleased with existing programs,[6] but there is no other evidence about placement rates, earnings, long-term employment of participants, or changes in the firms' productivity. In some state programs, the concern with the firm as the principal client and the desire to make firms as receptive as possible to public programs have led to efforts to minimize red tape and reporting requirements, reducing the information available about any aspects of programs (Stephens, 1987). Some have argued that the satisfaction of firms with existing arrangements is all that matters, and other measures of outcomes are superfluous. But this position is surely extreme: if the purpose of customized training is to promote economic development, as measured by employment gains in an area, earnings increases, firm productivity, and overall production (or regional product), then it is insufficient to know simply whether firms are pleased with the results of vocational education and training. Over the long run it will be necessary to develop better information about the effects of these programs, for different groups of individuals, under varying economic conditions.

However, even this brief review of a small and non-random sample of customized training programs reveals how much is going on. Many of the programs have the potential for exploiting the real strengths of customized training programs: they appear to be genuine collaborations between employers and educational institutions, and many can combine firm-specific and highly customized training with more general education. The potential problem of bias in selecting applicants may not be a serious issue. In general there appears to be a division of costs between the public and the private sector, rather than large numbers of cases where the public sector bears the costs of wholly private training. The effects of these programs on the the long-run employment of participants and on the productivity of employers remain unknown, but,the structure of existing programs seems to live up to many of the claims made on behalf of customized training.

Some Conclusions and Recommendations

One implication of this analysis is that customized training — indeed, all vocational programs intended to enhance economic development, and all partnerships — should be more systematically evaluated, since not all such programs will enhance employment, earnings, income, or productivity even in cases where they satisfy all the immediate participants. The evaluation of such programs has not even begun, partly because such evaluations are technically difficult, and examining the effects of educational programs is notoriously hard. Still, the variety of customized training is astounding, and these programs provide examples for efforts to disentangle what works and what doesn't. One obvious and preliminary step would be to undertake systematic surveys of such efforts, to ascertain their intentions, the kinds of firms they help, the division of costs, and the potential effects. Yet another would be to induce more vocational programs — including these new programs — to evaluate their own consequences, as a way of building up increasing amounts of information about the effects of such programs. This would be part of a much larger agenda to increase the amounts of information available about the effects of vocational programs for students completing them and for the firms in which they work.

Until more information is developed on the effects of different types of economic development efforts, there can be only the sketchiest implications for policy. However, one obvious conclusion is that states and the federal government need to be concerned with economic development efforts that merely reallocate existing employment among localities and states, rather than adding to employment and productivity in the aggregate. While the conventional wisdom is that "smokestack chasing" is outmoded as a model of economic development, there are still many anecdotes (as well as nationally-publicized efforts of states to snare such prizes as the Super Conducting Super Collider and the Sematech Corporation) suggesting that these "beggar-thy-neighbor" practices have not been abandoned. The persistence of "smokestack chasing" can be traced to an imbalance between local incentives and state purposes — where community colleges have every incentive to increase local employment, even at the expense of another region within the state — or between state incentives and national goals. Therefore the only long-run solution is for state governments and federal policy to counter these incentives, at the very least by insuring that their resources are not used for smokestack chasing.

Another recommendation involves the need for more careful targeting of economic development efforts, including customized training. While vocational education has the potential for enhancing productivity, and doing so without increasing prices or inflation, vocational education does not *automatically* lead to such benefits since the nature of demand limits its effects. If demand is insensitive to price, then increases in employment and wages from either training or retraining are likely to be small, implying that vocational programs should be targeted on those occupations for which demand is relatively responsive to supplies of trained workers and to wages. The use of vocational education to alleviate skill shortages again assumes that vocational programs are targeted only on those occupations for which skill shortages are known to exist (and not merely on occupations for which employers complain about their inability to find enough workers at low wages). Similarly, the use of vocational education as part of a strategy to stimulate exports, or reduce reliance on imports, requires limiting public subsidies only to certain sectors of a local economy. Targeting of vocational education on the occupations and the firms which might expand employment and production, rather than supporting vocational education in general with the hopes that economic development will magically materialize, is still unfamiliar to most (but not all) states, but it is an obvious corollary of realizing that some vocational education for certain occupations and sectors is unlikely to enhance economic development.

Another obvious recommendation is that governments at all levels should continue to stimulate demonstration projects and "experiments", encouraging postsecondary institutions and job training programs to develop innovative approaches — and then to evaluate these efforts carefully to ascertain their consequences. In the past such evaluations have been infrequent, and even the federal government has avoided much evaluation of vocational programs. For example, some program improvement funds available through the Carl Perkins Act could be earmarked to evaluate the effects of customized training programs on economic development[7] and the results would be instructive to institutions deciding which programs to institute. In addition, states can undertake their own demonstration projects, as they frequently do when they develop pilot programs or novel approaches to job training, using either state resources or federal funds from the Perkins Act and the Job Training Partnership Act.

The postsecondary institutions providing vocational education and training are now like laboratories — laboratories of educational experimentation, trying new program models, new approaches to old problems of preparation for work, new methods of working with firms and with other training agencies. The amount of ferment in this area is astounding, indicating both the importance of this subject and the creativity which educators and employers are bringing to new models. Some of these experiments will prove not to work, while others will undoubtedly be judged successful and then institutionalized in state and federal policies. But such discoveries are part of the normal process of developing new approaches and techniques. What counts for the moment is that there is so much activity from which to develop the next generation of vocational programs.

Footnotes

[1] The most important of these is the use of programs to balance variations in unemployment rates, for example by luring employment from low-unemployment to high-unemployment regions. On the limitations of vocational programs in the service of economic development, see Grubb and Stern (1989).

[2] Oral presentation, David Mertes, Chancellor, California Community Colleges, "Illuminating the Learning Society", Center for Studies in Higher Education, University of California at Berkeley, Oct. 24, 1988.

[3] For other arguments for flexibility, see Doeringer, Terkla, and Topakian (1988) and Spenner (1988).

[4] There are 45 programs in the sample examined initially, including all those who applied to the AACJC in 1989. This analysis has been carried out by Robert Lynch at the AACJC, with support from the National Center for Research in Vocational Education. In subsequent research, he will gather additional information about these projects as well as developing a more comprehensive "census" of economic development efforts in community colleges and technical institutes.

[5] There is a 1:1 match in the programs in Idaho, Kansas (for retraining only), Kentucky, Massachusetts, Missouri, New Mexico, and Ohio; the 1:1 match in Delaware and New Jersey can be waived in some circumstances; and Indiana's Basic Industry Retraining Program pays 25 percent of the costs. In the other twenty or so states with programs there are no contributions required from businesses, though what contributions firms make in practice is unknown. See Grubb and McDonnell (1989), Table A.1.

[6] Of course, the bias in our sample — its restrictions to those that have nominated themselves for the KAW awards — will generate more bias in comments about how well programs are working than in other descriptions of programs.

[7] For the proposal that federal support of postsecondary vocational education support more "coordinated social experimentation", see Grubb (1989).

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Reflections on Customized Training

RICHARD HOFSTRAND

This paper will briefly reflect on some of the comments made by Dr. Grubb. The first issue is to remind you to make a distinction between education and training. Often times, those terms are used interchangeably, yet they are so different. We often talk about customized training. I don't think that there is any kind of training other than customized training. All training is customized, but not all education is customized. Often times, vocational education tries to chase the employer, giving to the employer whatever it needs. With all due respect to the private sector, the employer tends to want what it is not getting. If it is not getting basic skills, that's what it wants; if it is getting basic skills, then it wants advanced skills; if it is getting advanced skills, then it wants something else. Whatever is not getting, that is what it wants. Yet for education to have to move into a training mode is difficult because education is a long-term benefit while training is a short-term benefit. It is therefore, important to sharpen your focus on the definitional distinction between education and training.

The second issue pertains to collaboration. Collaboration is pulling together the efforts and resources of existing agencies and entities. I remember several years ago issuing an RFP from the Illinois State Board of Education. We were trying to do a statewide master plan for vocational education and training. We had great dreams. They didn't go very far because there was no incentive for Job Training or for anybody else to cooperate. This is not a new issue. Agencies have proliferated since Roosevelt's New Deal. In a time of

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growth and government expansion, we have tried to solve problems, economic problems, societal problems, or whatever type of problems, by creating a new agency. Where there is a new need, we create a new agency. We don't ask an existing agency to address that new need; instead, we create a whole new agency. When you to to Springfield or to Washington, D.C., and walk down the street and look at the names on the doors, you see more and more agencies for more specific needs, all publicly funded.

We are now at the point where we are trying to get them to collaborate. We are not in an era of collaboration but of consolidation. Legislative bills at both the federal and state levels discussing vocational education talk about eliminating some agencies and about consolidation; they don't talk about partnership or about collaboration.

HR7, which amends the federal Carl Perkins Act, drops the words "vocational education" and pulls together several agencies and consolidates them, wiping them out and creating new structures. Vocational education, JTPSA, special cooperatives and welfare are a few of the agencies affected. And here in Illinois the Hoffman Bill proposes to create a "super board" which would combine and reduce existing agencies. Collaboration assumes that the agencies are going to stay there. Yet, under the current legislative climate, these agencies may not remain.

The next point I would like to make is that you need to be careful about economic development. Economic development is an elusive mistress. It's a great thing to talk about; nobody wants to talk against economic development. Dr. Grubb is correct, however, when he states that Urbana is robbing from Champaign, Champaign is also robbing from Urbana. Coles County, Mattoon, and Charleston are fighting amongst themselves as to who is going to get what. The biggest growth industry right now is economic development. If you want a good job, go into economic development. More people were hired in Coles County in the last year in economic development than in anything else. But what is going to happen when the economic development industry collapses?

Those of you who remember Sputnik in October of 1957 may recall the Time Magazine article that came out afterwards. The article discussed this country's needs for political security. It stated that we need more engineers, more development, more ideas, and more education. If you were to take that article from Time Magazine, 1957, and replace the words "Soviet Union" with "Japan," it could fit right now. The only difference is that in 1957 we were looking for political security, now we are looking for economic security.

We in vocational education are in major trouble right now. We are going through some major revolutions, some major dismemberment. Yet the need for vocational education on the secondary and post-secondary levels is so prominent that we are probably, at this point, setting the stage for a whole new revolution. If you compare 1989 to 1889, the same kinds of things are going on now as were occurring then. We need more training, more use of industry, and more technology, just as they did then. We are going through a hundred year cycle, just as predicted. Thus, we are probably setting the stage right now for what may be called the Smith-Hughes Act of 2017.

The last point that I will address concerns a question asked by Dr. Grubb: What are the long term effects of training on employees? We asked that same question to technicians at Illinois Consolidated Telephone Company. That company, based in Mattoon, is one of the largest privately owned telephone companies in the nation. It has technicians who have been employed there 10, 20, and up to 30 years. We went to their employees and asked them how they keep up on their job, how they keep current, since so much of the technology and equipment has changed in the past years. They said, "We don't." We asked, "What do you mean you don't keep up to date, why don't you keep up to date?" They replied, "We can't. In this business, things are changing so fast that by the time we can master one set of technology, there is a new wave that takes over and the old set becomes obsolete. We learn just enough to get by, just enough to keep the infrastructure steady, but then we wait for the next wave because that will make the old one obsolete."

Some predict that by the year 2010, we will work about a 25-30 hour week and that the rest of our work week will be spent learning how to do our next job. Thus, it seems clear that in our rapidly changing technologies, training to keep employees apprised of their development will be imperative.

A Reaction to "The Developing Vocational Education and Training 'System': Partnerships and Customized Training"

TIM L. WENTLING

The delineation of the developing vocational system over the past three decades by Grubb presents us with an interesting account of how our system has changed. The postulated hostility between the private and public sectors, however, has not been evident to the extent described, at least not at the micro level. That is, my experience and research reveals a great deal of dialogue, idea sharing (through local and state advisory groups as well as individual contact by educators), and shared governance where business and industry representatives serve on local and state boards of education.

I find the concept and practice of customized training a growing reality as Grubb does. However, there are several points that I think are important to consider as one looks at customized training as a vehicle for economic development.

First and most general, training may be viewed as a solution rather than as a contributing element to a solution. Research related to manager behavior reveals to us that a managers preparation, experience and position have a major influence on how a problem is viewed and defined. For example, a finance manager observes a problem and sees it as a finance problem, an engineer may view the same problem and define it as an engineering problem, and so on. It appears that where one sits has a lot to do with where one stands.

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With regard to economic development, I think it important that we not view it as a training problem just because we are training or education specialists. Economic development is a very massive issue that involves politics, economics, geography, sociology and to a minor extent training. I would not suggest we avoid the issue; I would suggest we take great care in maintaining proper perspective.

A second point that I view as important has to do with how economic development and customized training relate to the mission and goals of vocational education and its institutions. Admittedly, mission and goals vary across states and within states, but I think it is critical to measure all new activities (including customized training) against these institution guiding statements. In periods of rapid decline or erosion of resources or clientele, institutions often look for immediate solutions and new groups to be served. Without the proper planning and thought, actions may violate basic tenants held by the founders and managers of these institutions. For example, customized training in the lay sense, is typically focussed on one company. If local, state or federal tax dollars are used in delivering service to this one company, then questions of equity and equality may arise. Are all companies given the same opportunity? Are individuals of the community all given equal access? What is the opportunity cost for delivering this training. These are but a sample of the questions that should be answered in the consideration of new customized training activities.

Third, customized training presents itself to vocational educators, both policy makers and practitioners, in a very timely fashion. With changes in the secondary school related to school reform, with changes and proposed changes in federal legislation, and with changes in the workplace due to economics and technology, it is timely to reconsider the role and mission of vocational education. Grubb refers to firm specific training as an example of "narrow vocationalism". This occurs, at the same time many state and national leaders are calling for the integration of academics and vocational subject matter (that appears to be generalizable vocationalism). Grubb refers to and I strongly support the notion of measuring the effect of changes on individuals, not just state or local economies. Some forms of customized training could improve the productivity and profitability of a business and at the same time limit the wages and opportunities of individual employees. I don't want to imply that narrow and generalizable vocationalism need be exclusive. I only want the significant alternatives to be judged in light of their impact on more than economic development.

A fourth and last point that I view as important to this issue relates to change. Change is a concept we all acknowledge and live. Each of us changes, our professional roles change, our institutions change (some more than others), and even the bureaucratic red tape of our institutions change. We have several alternatives in the change process: lead, follow, or get out of the way. I strongly believe that we, as professionals in vocational education, should lead in the implementation of change. We should be evaluating the consequences of proposed changes, we should be evaluating the implementation of new programs (I obviously support Grubb's first recommendation), and we should use our results and new knowledge to inform policy development and facilitate the implementation of new programs and activities.

Customized training provides an opportunity and a challenge to vocational educators. It should be examined (and I applaud Grubb for his attempt at this) and it should be tested. It should, however, be viewed in terms of the big picture of education and of vocational education and it should be viewed in terms of the long term as well as the short.

Promoting Technology Transfer In Community College Programs: The Michigan Experience

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JAMES JACOBS

This paper will discuss one approach to how community colleges can become active in the area of technology transfer. In this unique partnership a not-for-profit research organization is serving as a catalyst for change within Michigan community colleges. While this might appear somewhat far afield from the traditional discussions of vocational education, implicit in this analysis is the contention that the changes in manufacturing technology, in particular the problems associated with the implementation of this technology, present to vocational educators a new situation that makes it necessary that new strategies be adopted to develop workforce skills. The initiation of the Liaison Office is one example of how vocational educators can respond to this new situation. Finally, while this paper will discuss some of the industrial trends relating to the new manufacturing technologies, and the policy content in which technological implementation is ongoing, it will only tangentially refer to the specific substantive issues of what "new skills" or "new courses" are necessary as the result of the new technologies. Rather, this paper will concentrate upon the impact of these technologies upon the delivery of vocational education.

Technology Transfer-What Is It?

From the outset, there is need to define technology transfer. For our purposes technology is "any tool or technique, any equipment

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or method of doing or making, by which human capability is extended." (Schon, 1967) This definition consciously attempts to broaden the understanding of technology from that of a material thing, or simple object. Technology includes the functions a particular tool serves and the "interactions that tools have within their social setting." (National Science Foundation, 1983).

This definition permits a view of technology as a process which includes the organizational forms that are necessary to utilize the tools. Thus, how technology is transferred becomes an examination of a process which includes far more than the simple adoption of a tool or new method. For example, computer numerical control (CNC) as a specific hardware was "invented" in the United States in the late 1940's through the joint efforts of a number of Michigan engineers in the machine tool industry. (Noble, 1984). Yet, 20 years later, the United States lagged behind both Japan and Germany in the number of CNC mills found in the industry. The country which has the most robots per worker in industry is Sweden--a nation long distinguished for its advanced human resource practices (Unterwerger, 1986).

There is no one "correct" way to introduce technology. Approaches will vary depending upon the past practices of the industry, the market the firm faces, and the existing labor supply. Given this, technology transfer is the process by which technology is diffused within the firm. That process might contain a series of steps or implementation stages of which training is only one stage. (Manufacturing Studies Board, 1986) The role of educational institutions may not be restricted to only this stage.

What this definition attempts to avoid is the mechanistic view that technology transfer is informing firms that there is a new process or way of doing something which they "should" use. The process by which technology is transferred becomes far more interactive between the source of the technology, and the end user. In addition, unless there is an organizational commitment to this change, it will not easily occur. It is especially influenced by many factors external to the firm, most specifically the market condition it confronts. (McAlinden, 1989)

The Implementation of New Manufacturing Technology

It has now become conventional wisdom that one major strategy for dealing with the increasing challenge of international competition to American manufacturing is through the rapid deployment of computer based manufacturing technologies. Briefly stated, these new technologies involve the integrated use of computer or informational technology in the planning, control and actual performance of production. They include not only the hardware--robots, PLC, Computer Aided Design (CAD) etc. but the "softer" new technologies of Statistical Process Control (SPC), MRPII and other data base systems that integrate the process of manufacturing. Finally, although often not considered in much of the literature, is the use of newer material composites and sophisticated materials that permit new products to be produced out of cheaper, more flexible materials. (For a discussion of these technologies see: American Machinist, 1983.)

The rapid introduction of new manufacturing technologies would, proponents claim, reduce unit costs, develop greater efficiency in design and management functions, increase quality, and enable the entire production system to be flexible in response to changes in the work place. While there were vigorous debates among commentators as to how much the new technologies would radically alter the development of productions away from mass production to flexible specialized niches, (see Piore and Sable, 1984), the assumption was that American industry would profit by their rapid introduction. It was on this basis that state policy makers in Michigan established the Industrial Technology Institute in 1982 to promote the rapid research, development and deployment of advanced manufacturing technologies.

What is important, however, is that despite the significance of these technologies, their actual process of implementation has been remarkably slow, particularly among the small and medium size industrial firms. The Industrial Technology Institute completed an extensive survey of 1,386 manufacturing companies in the Great Lakes Region of the United States. There were major differences between the implementation rates of the large and small companies (see Table 1).

TABLE 1

GREAT LAKES REGION

IMPLEMENTATION STATISTICS

Database: 1386 establishments

Firm Definitions:	Small (39%)	10-49 employees
	Medium (37%)	50-249 employees
	Large (24%)	250+ employees

Establishments which have the following technologies:

	Small	Medium	Large
Auto Inspect	3	10	30
Robots	3	10	32
Material Handling	3	10	26
CAD	12	21	9
CAE	4	6	29
NC/CNC	17	31	61
Program Controller	11	27	50
Production Planning	50	78	86
Local Area Network	9	16	40
Group Tech	12	23	28
SPC	18	38	60

For example, the adoption of robotic devices in companies with less than 50 employees is 3% and for firms over 50 employees it is 30%. For CAD, the implementation rates for small, medium and large plants are 12%, 21%, and 49% respectively. For Numerical Control/Computer Numerical Control (CNC), the implementation rate for firms is 17%, 31% and 61% respectively.

This uneven adoption of the technology is particularly disturbing because many of the smaller, partmaking supplier plants are under the dual threat of international competition and pressure from their customers (in general, larger firms that assemble their parts into products) to introduce quality into their production process. Part of the reason may be found through other responses to the same survey. Respondents were asked what the principle reasons were for the successful implementation of the new technologies (see Table 2). The two most often cited responses were hourly workers' skills at operating the new technology and hourly workers' skills at maintaining the new technology. It is interesting that cost of the technology, or the inflexibility of work rules, were not cited as barriers.

The Industrial Technical Institute (ITI) data has been supported by other national and regional studies (Kelley and Brooks, 1988, Jacobs, 1986). What emerges is that the patterns of computer based technological implementation is uneven, with the small and medium size shops only beginning to consider the adoption of the technology. In addition, in the process of adopting the new technology what appears decisive is the pre-existence of a skilled workforce to implement that technology. Thus, the challenge for the firms is how to retrain their present workforce to realize the productivity gains of the new technology.

While the long term goal is the development of programs through public and private educational institutions that will be able to continually channel workers with the skills necessary to implement the new technology, the short term emphasis is a trained workforce. Without this workforce, the technology will not be implemented. In February 1989, a survey of 300 plant sites in Michigan indicated that firms were devoting their major emphasis toward the retraining of their present work office (Table 3).

New Manufacturing Technologies and Vocational Education

The new manufacturing technologies present challenges to vocational education in a number of ways. First, the main thrust of

TABLE 2

FACTORS AFFECTING SUCCESSFUL IMPLEMENTATION OF ADVANCED MANUFACTURING TECHNOLOGIES

Factor	% giving score of 4 or 5
Hourly Workers' Skills in Maintaining and Repairing New Technologies	22.8%
Hourly Workers' Skills in Operating New Technologies	22.3%
Timeliness of Equipment Delivery	21.1%
Technical Staff's Knowledge of New Technologies	17.8%
Union Work Rules	16.1%
Operator Attitudes toward New Technologies	15.6%
Software Suitability for Desired Application	14.4%
Schedule Established for Implementation	11.7%
Technical Support or Documentation from Vendors	11.3%
Equipment Compatibility with Existing Operations	7.6%

Source: Industrial Technology Institute, Frostbelt Automation, Ann Arbor, Michigan, 1987.

TABLE 3

HUMAN RESOURCE ISSUES: QUESTION RESPONSE PERCENTAGES

Question Number	Are you currently:	Percent Responding More	About the Same	Less	No.*
11	Investing in Technical Training for Existing Work Force	79	19	2	124
12	Extending Efforts to Upgrade Basic Skill of Work Force	78	22	1	125
13	Selecting New hires on Basis of Educational Attainment & Degrees	51	47	2	121
14	Using Participative Decision Making Approaches	75	25	-	124
15	Using Pay for Knowledge Compensation Practices	32	67	1	110
16	Doing Strategic Planning on at least two-year Time Horizon	58	42	1	125

*The sample size responding to each question changes because some plants do not engage in the activity questioned. Thus, percents reflect only those responding to each question.

industry, in order to implement the technology, was to retrain the present work force. One major form taken by community colleges is the development of customized or contracted training. These are classes taught by institutions for business clients that may incorporate some of the material of traditional classes but in their objective and thrust are expressly designed to serve the needs of that business. Often they are taught without any college credit given. Many times these courses are offered on the site of the employer.

There has been an unprecedented growth in the demands for customized training courses. For example in the state of Illinois, in 1985 employee training done by community colleges affected 22,000 individuals from 900 companies. (Isreal, 1987) Two years later, the same schools served 1,395 companies and over 37,000 students. (Illinois Community College Board, 1987.) In Michigan, while the number of students in the traditional vocational education courses has declined by 8 % in the period from 1984-87, a survey of customized training units indicated a 56% increase over the past seven years (Jacobs, 1989).

The growth of customized training appears to contradict the conventional definition of vocational education i.e., to give students skills for entry level work. These were students who already possess jobs and wanted to be trained either on new skills to maintain their present jobs, or skills which would lead them to advancement. Indeed, the distinction between "training" and "education" is blurring as the firms and the workers are interested in both skill specific training to learn a particular task, and education in a general area to establish a career path.

These students, and more importantly their companies were less interested in taking an entire vocational education program. In determining programs offered by an institution, the vocational education system was not considering the demands and needs of the firm. In the past the only unit of consideration was the student. This means that the standard assumption of having a staff derived "from industry" takes on a far different meaning. Vocational educators must not only *be from industry,* they need *to know about industry*. The monitoring of industrial trends, both in terms of processes and products with firms, becomes an important new task for the vocational educator.

If the main demand for vocational education comes from the present workplace, then some of the components of the courses need to deal with the problems of implementation of the technology as well as the skills associated with the operating of it. The conventional course of study in vocational education tends to teach skills which permit an individual to operate a piece of equipment or set of interrelated equipment. One can learn to be a CAD operator at most community colleges and develop sufficient skills from a program to perform most 2-D drawings. However, if a firm is to realize the productivity gains from CAD it requires an understanding of how the process can be applied to making libraries of parts, to storing CAD generated information and manipulating it, and to developing an ability to pass that data to other machines such as cutting tools. In general this makes it incumbent that the CAD operator has the ability to understand how this technology fits within the production strategy of the firm. Too few CAD courses contain information about the management of the CAD system within the firm. (Arnsdorf and Jacobs, 1988)

Second, the new manufacturing technologies call for more attention to the use of basic skills to compute, communicate, and reason out answers to problems. The concern for basic skills at the workplace has already been amply demonstrated by both industrial and government sources (Chisman, 1989). What is less understood is how these skills can be integrated within the present technical training performed in vocational education courses. The teaching of most vocational education classes is based on repetition and learning by watching others, an approach which is useful, but needs to be coupled with the use of basic skills concepts within these classes. It is disturbing that such subjects as mathematics are "segregated" from the vocational education programs only to be taught by liberal arts faculty. Basic skills need to be part of the vocational education program.

The need for basic skills is especially important because the application of new manufacturing technologies to particular problems is extremely diverse. There is not one way to implement CNC technology in terms of programming the equipment. In some firms, the programming of the machine is undertaken by the engineering department far removed from the shop flow. In other firms, program adjustments are made by the operator of the equipment. What is the most advantageous method depends on the specific strategy of the firm. This new flexibility the technology brings to the workplace means that if gains are to be realized by the firm, workers must possess broad general skills and the the ability to learn and adjust skills at the workplace.

Third, the new manufacturing technologies certainly decrease the amount of direct labor involved in manufacturing, but raise the skill levels, and the demand for a good deal of work directly associated with industrial production. The repair and maintenance function becomes increasingly more critical.(McAlinden, 1989) There are many tasks related to software development, positioning of machine vision systems, and quality control of operations. All of these tasks are performed by skilled workers, often those upgraded from the initial production level work. The challenge to vocational educators is to develop programs which train workers in the skills necessary to advance along what has been termed the labor queue (Piore, 1971). The recognition that firms, particularly small and medium size firms, will advance their work force is an important concept to build into vocational skills programs. Thus, a combination of basic skills, plus knowledge of the internal labor market of firms are important for successful community college vocational programs.

Fourth, the new manufacturing technologies present a dual challenge to the vocational education administrations in that they often require both new equipment (computer controlled) and staff development. In most community colleges, the faculty in the vocational education area received their technical training in the pre-micro computer area, and unless there have been adequate staff development plans, they have probably lagged behind the development of the technology. A recently completed national study of exemplary national studies found that many community colleges have purchased modern equipment, but few have undertaken the staff development necessary to teach some of the techniques of advanced manufacturing technology (DePietro, 1989).

There has been major attention to the development of "Technology Centers" at community college campuses. Indeed, the American Association of Community and Junior Colleges now has organized a national association of technology centers which will share information on educational development and the relationship of these centers to their local industrial concerns (ACTC, 1989). However, there has been no similar thrust in the area of staff development. At least in Michigan, funds allocated to staff development of vocational instructors under the Perkins Act are underutilized by the vocational deans while equipment monies are used up entirely.

Pursuing the traditional strategy of more "equipment" may be strategically short sighted given the principle term goal of retraining present workers. Most firms possess better "state of the art" equipment than public educational institutions. If they are small and medium size firms they are more likely to want workers trained at their plant and permit the community college access to their equipment.

Finally, the introduction of new manufacturing technologies is very much connected to the particular crisis affecting American industry. Where in the past vocational educators could respond to industrial calls for more workers in an era of a growing industrial base, today the industrial structure is in shambles. Indeed the "partnership" between business and education is one in which educators are now needed by business to restore competition (Cohen and Zysman, 1987). There is a partial economic development function for vocational education at the post-secondary level. Larger manufacturing firms have lost over 1 million firms since 1967, while the small and medium size firms have grown by 1.3 million. In the mid-west alone there are 25,000 such foundation firms representing over 2.3 million jobs. Given the present patterns of supplier relations, and the potential that new manufacturing technologies pose for lower unit costs, these firms may have an optimistic future--if they can modernize. In large part it will be these firms that provide the future jobs for vocational education programs.

However, working with these foundation firms poses serious problems for vocational educators. First, almost all of the "business" input to vocational educational programs tends to be dominated by the large businesses. This means curriculum has to be developed to meet the needs of the larger firms. Second, even the development of programs assumes certain job classifications and titles that tend to be more blurred in the smaller smaller manufacturing establishments. It is likely for an electrician in a smaller shop to also perform some welding operations, thus in a vocational program, both skills should be taught. Indeed, the general concern for the smaller shops is to have a good technical "generalist" that can been trained on the job to handle the specific tasks of the plant (Jacobs, 1987). Most vocational education programs tend to produce specifically trained individuals, without the flexibility to adapt on the job.

Finally, working with smaller industries does mean that training of the work force is only one of the potential interactions between the community college and the firm. It is these firms who need executive awareness sessions concerning the new technology so they can determine if its implementation would be useful. In addition, it would be useful to have demonstrations available on how this equipment can be used to manufacture certain products. This point may only mean the demonstration of proven technologies but, as an economic development role, this can be vital to the business retention efforts of a particular area. In brief, the work with the foundation firms increases the potential that the community college vocational staff will engage in other stages of the technical transfer process.

The ITI Liaison Office

The ITI Liaison Office was initiated to aid Michigan community colleges in dealing with some of the above new challenges. However, in order to understand the functioning of the office, it is necessary to place it within a perspective of how ITI, the Liaison Office and Michigan community colleges fit within a general economic development strategy of the state.

This major industrial state was one of the hardest hit by the economic downturn of the early 1980's. State policy makers developed a strategic planning consensus that argued if Michigan industry was to remain competitive, firms would need to " get smart " through the rapid deployment of computer-based manufacturing technology. These new technologies would increase productivity, and retain industrial jobs (Michigan Department of Commerce, 1984).

One critical aspect of this state strategy called for the creation of an applied research center in advanced manufacturing technology. This was the Industrial Technology Institute, a not-for-profit research, development and deployment organization composed of over 135 people, primarily from industrial and engineering backgrounds. While the Institute has a particular relationship with the State of Michigan, its overall mission is to promote the deployment of manufacturing technologies throughout the United States.

The original plans for the Institute included a tie with community colleges. On the original Board of Trustees was placed Dr. Albert Lorenzo, president of Macomb Community College--the largest Michigan community college. The relationship between community colleges and ITI was programmatically joined in 1986 under a grant from the Michigan Department of Education and a Community College Liaison Office was established at ITI. The task of the Liaison Office was to relate the expertise of the Institute to the needs of Michigan Community Colleges. The office was staffed by an individual from a Community College who was "on loan" to ITI. In the past three years the Liaison Office has undertaken the following types of activities with Michigan Community Colleges:

- conducted a survey of 200 Michigan automotive supplier firms to identify their present and future training needs.

- evaluated a Statistical Process Control program taught by Michigan community colleges to small and medium size manufacturing firms

- undertaken a feasibility study for determining whether a community college should initiate a high technology center at one of its campuses

- worked as an "implementation team" with a community college providing specific technical expertise to that institution which was engaged in a customized training process with a particular firm

- developed a Customized Training Institute to train Michigan community college staff on how to relate to the training needs of Michigan manufacturers

- worked with a joint union-management training committee to develop a design for cross training of skilled trades that would be undertaken by Michigan community colleges

- conducted a feasibility study for the implementation of telecommunications for a particular college campus

In addition to these specific activities to community colleges, the Liaison Office performs research for the Michigan Department of Education, and works with the Michigan Occupational Deans Administrative Council conducting specific research on a number of issues of curriculum and skill needs.

The purpose of the Liaison Office is to bring technological expertise plus the research capabilities of ITI to the college's efforts of developing programs in the new manufacturing technologies. The Department of Education believes it is essential for Michigan community colleges to develop their understanding of new manufacturing technologies so they can remain relevant to the changes in the Michigan workforce. This partnership to an applied research center makes Michigan community colleges more able to respond to the needs of industry.

What is perhaps equally significant is that in Michigan other units of state government also saw the need to utilize the community college system as a means of economic development. In 1984, the Governors' Office of Job Training awarded a $500,000 grant to Jackson Community College to train instructors from all Michigan community colleges in the delivery of Statistical Process Control (SPC) program designed to be used by auto supplier firms to qualify for the quality ratings from the auto makers. This program was important because colleges were awarded state funds from outside of the Michigan Department of Education in order to conduct an activity which would aid one of the three identified "critical" industries targeted for state retention efforts. The community colleges thus became an arm of state economic development strategy.

This initial effort with SPC was expanded in 1986 when the Department of Commerce started the Michigan Modernization Service (MMS). This agency is expressly designed to aid in the efforts of small and medium size firms in their adoption of modern manufacturing technology and business organization. A discussion of MMS is beyond the scope of this paper, but in essence firms receive from the agency a written technological report of their operations based on a plant visit by a trained engineer, plus a training plan in which they can utilize state funds if they use community colleges to conduct the training. Moreover, many of the MMS training agents are now housed at community college campuses, or are college staff shared between the community college and MMS. Presently, over 480 firms have utilized MMS services and the goal by 1990 is to service 1,000 Michigan foundation firms.

What is critical about the MMS activities is that there is a recognition that the community colleges can serve as an important training mechanism for the small and medium size firms. In the past year, most of the specific MMS activities and staff have been "privatized" and the bulk of the organization is now within ITI. As the result, the work of MMS and the Liaison Office have been more directly coordinated. For example MMS is now funding the Liaison Office to develop a series of workshops to be directed at union-management groups within these foundation firms. These workshops, which will try to prepare both union and management for technological change, will be offered through the community colleges. In another example MMS has provided the funds for ITI to develop a set of tools which can be utilized by educational institutions in order to work more closely with smaller manufacturing firms to pinpoint skill shortages.

The Michigan experience is an example of how a decentralized community college system can be "organized" by state authorities to serve the economic development priorities of a particular state. In many instances monies and programs were directed at the community colleges from other sources in the traditional Department of Education. As a result, some of these funds have actually led to the development of the customized training capacity of these institutions often quite separate from the traditional vocational education system. The result has been a shift in emphasis away from the conventional vocational education system and toward the retraining of the present work force though customized training. In Michigan, while traditional vocational education has declined slightly on the postsecondary level, the customized training efforts have increased by 56% over the past six years.

Lessons From The Liaison Office

The Liaison Office was principally designed to increase the capacity of the community colleges of Michigan to respond to the challenges of new manufacturing technology. How well has this mission been accomplished? There are some signs that the relationship between Michigan community colleges and ITI is having positive relationships in a number of important areas:

First, the traditional occupational deans of the community colleges are beginning to pay more attention to the significance of research into the firm's strategy as a means of driving institutional decisions about equipment purchases, staff deployment and curriculum offerings. For the first time the state professional organization, the Michigan Occupational Deans Administrative Council (MODAC), has established a research committee that regularly reports on the trends to the group. This committee has begun by simply analyzing the data that state authorities regularly gather upon the vocational education system. Thus, for the first time the MODAC meetings were coordinated with the meetings of community college institutional research organization so that these two organizations could begin to understand the role of research in guiding decision making for the development of programs.

Second, the Liaison Office has played a critical role in the development of the state wide customized training efforts through the development of the Customized Training Institute. This organization has trained over 60 individuals in how to relate to the manufacturing needs of Michigan manufacturers. In addition, issues such as training design, negotiation with clients, how to select subject matter experts, and a variety of other administrative questions have been examined in the Customized Training Institute.

The Liaison Office has conducted ongoing research evaluating the Customized Training function for Michigan community colleges. A student evaluation of the SPC programs reveals the needs for the colleges to participate in the implementation of the technology with the firms (Jacobs, 1986). The Liaison Office also conducted a task analysis of what departments of customized trainers actually did at the Michigan community colleges. On the basis of this information the Departments of Education and Commerce are redesigning 1989 and 1990 sessions of the Customized Training Institute (Jacobs, 1989).

The Customized Training Institute has been very important in breaking down the traditional barriers between colleges. The demands for good technical training in the computer based technologies are forcing schools to share specialists and develop a sense that service to the firm is more important than loyalty to the particular college. In addition, because the Customized Training Institute (CTI) is partially funded through the Michigan Modernization Service, there has been active participation in CTI sessions from other parts of state government. This has aided the community colleges in understanding how their work fits within the general economic development strategy of the state.

Third, the Liaison Office has aided community colleges in direct contact with business and industry. The office has been able to serve as part of a community college team bringing technical expertise to specific projects with firms. The office has worked with industry and unions to develop training specifications so that Michigan community colleges can bid on specific jobs. In addition, the Liaison Office has worked with all the joint training funds attempting to have community colleges serve the needs of the various funds in the design and development of courses for UAW workers.

Finally, the Liaison Office attempts to promote a strategic view which sees the specific mission of vocational education as working with small and medium size firms. This is done regularly through MODAC, the CTI, and direct work with community colleges. In large measure the view of serving the foundation firms emerges from state economic development policy initiated by the Department of Commerce.

Education And Technology Transfer:
Lessons Learned

In the past three years, a number of important lessons have been learned from the work of the Liaison Office. First is the need for more vocational education transformation to be directed by the criteria of economic development. In a sense, community college vocational educators need to reorient their action to less of an attempt to chart out curriculum changes and program development within their own institution, but more to a view which perceives vocational education as part of a larger response to the difficulties of retraining manufacturing establishments in an era of international competition. This approach will lead to more sharing of resources, less replication of services, and more ease of quicker adjustment to the shifting realities of the student market. To make an analogy, the vocational education system needs to move away from a "dedicated" system of offering packaged courses over specific time periods within heavily structured programs, to a more "flexible" system that is able to strategically adjust course offerings to meet the needs of specific firms (DePietro, 1989). Accepting the economic development criteria of the state as an organizing device becomes significant in that an external set of criteria and expectations is imposed upon this public system.

Second, given this strategic orientation to mission, a major issue for vocational education becomes: what makes for a good vocational-education administrator? Despite a good deal of attention paid to community college "leadership" by a number of current studies (Rouche, 1986, Lorenzo, 1988), no one has examined the specific characteristics that would make for an exemplary administrator. There is a suggestion that good administrators are those who perceive themselves as "facilitators" for their staff, permitting them to concentrate on teaching (NAVE, 1987). This evidence does not shed any understanding on the skills needed for cost justification of equipment, negotiating with clients, and translating intelligence about industrial trends into courses and programs.

Third, the emphasis upon the firm as a client has produced a growing "division" between traditional vocational education and customized training. In many community colleges these two functions are under two different administrative units, and relate to separate missions of the college. Often customized trainers are unaware of the technical capabilities of their own staff, and they meet the demands by hiring outside consultants. This does little to develop the "spill over" benefit of this involvement with industry for the college. The customized training and vocational education program compliment one another and should be coordinated under the same mission and criteria for the college.

Fourth, staff development is a major priority for community college vocational education staff. There are three dimensions to the problem: one is that technical staff need to be up to date with existing technologies, and the process by which they are implemented within the firm they serve. Specifically, this means that certain "soft" technologies such as MRPII, and quality management need to be learned, as well as a greater appreciation of basic programming skills and elementary electrical skills for all vocational education students in manufacturing. Second, the faculty and/or staff need to be trained in how to work with industry, how to understand the internal labor market, how to identify skills shortages and how to design programs for a firm. Those skills are not often found in the present vocational education staff. Finally, there is a need for vocational faculty to develop skills at evaluating their program and performance to competency based standards. A good deal of vocational education research suffers from lack of evaluation skills. They look at programs in a systematic fashion, this would include cost justification issues. One major area for the Liaison Office in the year is in this area with seminars and briefings.

Finally, there is the issue of community college mission and economic development activities. While work with foundation firms may appear a correct utilization of these institutions, in practice, community colleges tend to work with larger firms. These industries can afford to pay colleges for services and often have long term programs which can benefit a variety of programs within the colleges. In addition, from the perspective of public relations and community relations, work with the larger firms wins greater visibility for the college.

Even in Michigan there are some disturbing signs that community colleges are not servicing the needs of the foundation firms. The largest Michigan program to assist the technology training needs of small and medium size firms is Michigan Job Opportunity Bank-Upgrade (MJOB). Data from the past three years indicates that the participation of community colleges as the training broker has actually decreased while the use of private trainers has increased (Table 5). This means there needs to be an assessment of community college mission, and a desire to overcome the institutional barriers that might make this work difficult within the college.

Conclusion

This paper has explored one partnership between business and industry--the formation of the Liaison Office at the Industrial Technology Institute. While the specific institutional arrangements may be unique, there is little question that the complex changes in manufacturing will bring a need for more connections between vocational education and industrial organizations. In this period, vocational educators need to recover their mission, which is to educate and train the American work force.

TABLE 4

Foundation Firms Are Becoming More Important...

Employment Shifts in Manufacturing, 1980-86

500 > Firms	-400,000
100< Firms	+1,300,000

TABLE 5

MICHIGAN JOB OPPORTUNITY BANK-UPGRADE PROGRAM

PERCENTAGE OF COMPANIES WHO USED

	1986-87	1987-88	988-89
NO KNOWN BROKERS	27%	20%	29%
COMMERCE DEPARTMENT	22%	27%	24%
COMMUNITY COLLEGES	32%	22%	18%
K-12 SCHOOL DISTRICTS	1%	6%	3%
LABOR DEPARTMENT	11%	9%	7%
PRIVATE TRAINERS*	7%	16%	19%

*Equipment vendors, private training companies, and professional organizations.

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Corridor Partnership for Excellence in Education

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Public-private sector collaboration in education has emerged as a new thread in the fabric of public education. As Timpane (1984) observed: "Of all the recent changes in the landscape of American education, none has been more dramatic nor swifter than the reappearance of the business community" (p. 389). The emergence of school/business partnerships parallels the excellence movement that originated in the business sector. The chronicles of the 1980's will record an era of "excellence," when Americans were "in search of it" (Peters & Waterman, 1982), attempted to "create it" (Hickman & Silva, 1984) and, once having found it, were consumed by a "passion for excellence" (Peters & Austin, 1985).

The development of school/business partnerships holds great promise for restructuring old relationships and for building a new social architecture in which education and business collaborate in essentially novel ways to promote enduring educational reform. Wise (1981) noted that the emphasis today is on taking a closer look at how the goals and programs of business and education are related. The National Alliance of Business (1986) concluded that partnerships with education are essential to the private sector's agenda for the 21st century. The salient question in assessing the effectiveness of school/business partnerships is whether these endeavors create new structures for school improvement, structures that relate to the paramount mission for public education--the instruction of students and the continuing professional development of teachers.

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This paper will describe a model school/business partnership in Illinois, the Corridor Partnership for Excellence in Education, the overall mission of the three collaborating organizations in northern Illinois, the Corridor Partnership, the Illinois Mathematics and Science Academy (IMSA), and the West Suburban Regional Academic Consortium (WSRAC), and factors which influence their sustained involvement. Major implications for improving public policy regarding education and economic development will be discussed. Finally, the major implications for teacher education and administrator education, continuing education and educational research will be examined.

Historical Background on the Corridor Partnership

Warren Bennis (1985), a well-known researcher in the area of leadership, has commented on the fact that leaders who create a compelling vision of excellence and sustain it, are the driving force behind successful organizations. The Corridor Partnership, located directly west of Chicago on I-5, emerged as an idea from the private sector in 1982. Walter Massey, Director of Argonne National Laboratory, and Leon Lederman, Director of Fermi National Accelerator Laboratory, ignited a vision among the leaders of the Valley Industrial Association Education Committee to become involved and to enhance elementary and secondary education in mathematics, science and technology.

The Corridor Partnership was organized in 1984 in direct response to the findings of the National Science Board Commission report released in 1983. Business and education leaders expressed serious concern that American youth generally were less than adequately prepared for the challenges awaiting them in the 21st century. These visionary leaders in northern Illinois were instrumental in generating an innovative proposal for action, Senate Bill 730, which later established the Illinois Mathematics and Science Academy (IMSA). Located in Aurora, Illinois, IMSA is the nation's only three-year state supported public residential secondary school for gifted students.

Common Mission

Corridor Partnership for Excellence in Education

The Corridor Partnership is a unique consortium of leaders representing a broadly based constituency from business, industry, research and development laboratories, elementary and secondary schools, higher education, government and labor in northern Illinois. The members of the Corridor Partnership endorse a collective vision of excellence and equity, the enhancement and promotion of high quality mathematics, science and technology education in the schools of Illinois. The Corridor Partnership has two primary goals based on this mission:

- To act as a catalyst in bringing together business research, education, government and labor leaders in Illinois.
- To serve as a broker in exchanging and sharingresources among business, research and education in support of and enrichment of mathematics and science instruction.

The Corridor Partnership aims its resources at three major levels of support: helping inadequate mathematics and science programs to become adequate; assisting adequate programs to achieve excellence; and supporting exemplary programs to remain outstanding.

Illinois Mathematics and Science Academy

Office of Outreach

The mission of the Illinois Mathematics and Science Academy Office of Outreach is to stimulate further excellence for all Illinois schools in mathematics and science. IMSA Office of Outreach accomplishes this mission through the following means:

- Stimulating curriculum development and revisions through the collaborative efforts of the inter-acting institutions involved in the Academy including universities, secondary schools, the industrial sector and national laboratories.
- Providing in-service training sites for persons in preparation for the teaching of mathematics and science.
- Hosting summer institute opportunities for Illinois teachers modeled after the successful National Science Foundation programs prevalent in the 1960's.

- Providing opportunities for the exchange of teaching and faculty seats at the Academy for science and mathematics educators in the elementary and secondary schools of Illinois.
- Creating the opportunity and potential to link vocational programs, and education for technology and employment programs, to the work of the Academy.
- Offering speakers and programs for teacher institutes and in-service training around the state.
- Providing videotapes of lectures and experiments for use in the schools of Illinois.
- Providing assistance in the identification of necessary competencies to be incorporated in public school district graduation requirements.

West Suburban Regional Academic Consortium

The mission of the West Suburban Regional Academic Consortium (WSRAC) is to serve as a broker and act as a catalyst in matching the resources of higher education to the growing and changing needs of business, industry and research in northern Illinois.

The focus of WSRAC is on bringing both institutional and innovative programs to bear upon the identified needs of the private sector through a collaborative approach.

Collaboration: Critical Vehicle in the New Social Architecture

The offices of these separate organizations, the Corridor Partnership, IMSA Office of Outreach and WSRAC, are located in Aurora, Illinois under one roof in the Illinois Mathematics and Science Academy building. The professional staff which serve in these three organizations practices in the microcosm what these respective organizations hope to achieve in the macrocosm through the collaborative model. The common mission which these three organizations embrace is the enhancement of excellence in education especially in the areas of mathematics, science and technology education for students at all levels of ability, kindergarten through post-doctoral.

The standard definition appearing in the dictionary asserts that "...collaboration is the act of working together, especially in a joint intellectual effort" (American Heritage Dictionary, 1981, p.202).

Collaboration is typified by joint planning, joint implementation and joint evaluation (New England Program in Teacher Education, 1973). This implies that the parties involved share both responsibility and authority for the basic policy decisions (Hoyt, 1978).

With a view toward educational institutions, Schaffer and Bryant (1983) concluded that collaboration is "...shared decision-making in governance, planning, delivery, and evaluation of programs" (p. 3). In a pluralistic society, where people of dissimilar backgrounds with equal status work together, collaboration may be viewed as working "with" rather than working "on" a person.

Critical Factors in Successful School/Business Partnerships

What are the critical dimensions of successful school/business collaboration? In a study of over 120 U. S. school/business partnerships, ranging in location and size, Dale Mann (1984) of Teachers College/Columbia University found four critical and absolutely necessary ingredients for successful school/business partnerships. These ingredients are:

- Vision
- A broadly-based constituency of support
- Commitment on the part of the group to a range of priorities rather than to a limited focus or single episodic project; and
- Endurance.

Of these four, vision is the most often repeated criterion appearing in the literature (Chaudet, 1985; Edwin, Jehl, Malanga & Ott, 1983; Hutchinson, 1983; and Timpane, 1984).

Vision

Clearly, collaboration is a very necessary vehicle in achieving excellence and ensuring equity in education. Moreover, if collaboration is the vehicle, then vision is the driver. In reality, vision must be translated into mission. Effective partnerships have very clear mission statements. The parties involved in the collaboration know why they are working together–they have purpose and meaning.

Constituencies

There is another factor in this vital and empowering equation: constituencies with broad bases of support. In the arena of school/business partnerships, there is some debate about philosophy, structure and approach. Some people refer to their work in the context of "Adopt-A-School" programs. Others describe their efforts as "partnerships" and still others embrace a more encompassing, but more challenging, notion of "collaboration."

Herein lies an important distinction. For example, when one talks about "adopting" a school, the term implies that one party in the relationship, namely the school, is different from the other and, in some ways, dependent on the other.

Schools are not orphans and not in need of someone older, wiser, more experienced and mature to guide their development. Business does not act in the role of "parent" with the schools. On the contrary, business people and educators must talk about and act collectively within a relationship that demands reciprocity, mutual standards of accountability, authority and respect. That is why a broadly based constituency is so critical to the success of collaborative endeavors between business and education. Such supportive structures lead to greater levels of involvement, deeper meaning and credibility as well as to wider ranges of resources and outcomes. If nurtured intelligently, broadly based constituencies mature over time into strong political alliances for public education. These alliances then move the agenda of excellence and equity much further than any one group or individual possibly can do alone.

On a pragmatic level, collaboration within the parameters of broadly based constituencies means team building. In working with teachers, collaboration means restructuring schools so that teachers are no longer isolated, but free to innovate as part of a team. Professional staff development within a collaborative model involves working with teams of teachers and administrators.

Commitment to More Than A Single Episodic Project

Single, episodic projects and events are not conducive to long-term, sustained school improvement. Such events rarely occur when the parties in the relationship engage in collaboration built around a well defined and clearly articulated mission.

Endurance

Research studies report that partnerships which are collaborative in nature and tend to endure over time espouse a strong vision of the future and involve a broadly based constituency of support and demonstrate commitment to an action agenda as opposed to a single project time (Mann, 1984; 1987). After studying the Corridor Partnership as part of his national research, Dr. Mann informed the Board that the Corridor Partnership exemplified vision, a broad base of support and commitment to more than a single episodic project. Since the Corridor Partnership is relatively young, it is still too early to say that it has "endured," but all indications, according to Dr. Mann, "...definitely point affirmatively in that direction" (Digate & Marshall, 1986, p. 5).

The Corridor Partnership has progressed through a number of critical stages into growth. Successful collaborative organizations evolve through critical developmental stages. Trubowitz (1986) described eight stages in the genesis of school/business collaboration:

-- Hostility and skepticism
-- Lack of trust
-- Truce
-- Mixed approval
-- Acceptance
-- Regression
-- Rebuilding and renewal
-- Continuing progress

Trubowitz cautioned potential partners to realize that collaboration moves through these different stages of development. To ignore these stages is to invite disappointment, frustration and possible failure.

Our experiences at the Corridor Partnership in working with a broadly based constituency of partners interested in and committed to improving mathematics, science and technology education has provided some insights into the process of establishing partnerships and coalitions on both the state and local levels. Essentially, this process involves five steps or stages. It is important to remember that these stages are developmental and some require more time to accomplish than others.

The following steps provide a suggested framework for building a partnership between business and education:

1. Define the need together.
2. Build a collaborative base through joint planning, implementation and evaluation.
3. Shape an agenda for action through a clearly stated mission and set of goals.
4. Develop programs and services based on articulated goals.
5. Implement plans and evaluate outcomes together.

Problem Solving and Critical Thinking in Mathematics

This process model of building a partnership is illustrated through recent program development at the Corridor Partnership. During the past four years, the Corridor Partnership has been developing, implementing, evaluating and refining a collaborative professional staff development model which involves teams of teachers and their building administrators. The focus of the project is centered on improved mathematics instruction through problem solving and critical thinking.

The program began as a result of the business and education communities identifying several critical needs:

- Upgrade the teaching of mathematics in the elementary and middle schools.
- Integrate problem solving and critical thinking into the mathematics curriculum at all levels.
- Support innovation in teaching through establishment of a collegial or team approach.
- Sustain innovation and improvement through development of connections and linkages with the private sector and teacher-to-teacher networking.

The collaborative base that identified needs and initiated the planning of this program included the research community, higher education, government and elementary/junior high school administrators and teachers. Specifically, "Problem Solving and Critical Thinking in Mathematics" began as a pilot project with support from the Department of Energy and Fermi National Accelerator Laboratory. Following an initial evaluation, the project was expanded through the efforts of the Illinois Board of Higher Education, IMSA, National College of Education, National Science

Foundation and numerous corporations including AT&T Bell Laboratories, Amoco Research Center, FMC, Illinois Bell Telephone Company and Motorola, Inc.

Teams of 3-5 teachers from the same school and their principal participate in an intensive week-long training program during the summer. The faculty for the training is a collaborative one, involving higher education personnel, exemplary elementary and middle school teachers who have been identified and trained as "teacher-leaders" and business people from each of the participating corporations.

Following the initial training, teachers and administrators commit to a year-long program during which "teacher-leaders" work directly with teams to facilitate the implementation and evaluation of the project within individual classrooms and schools.

The project employs an external evaluator to assess systematically the impact of the project on the achievement of students, improved instruction of mathematics, and the increased understanding and use of innovative approaches in teaching. Data are collected from students, teachers, administrators and participating private sector representatives.

The preliminary results of this collaborative effort have demonstrated the following benefits:

-- Increased integration of problem solving and critical thinking into the elementary curriculum among participating schools.
-- Increased support for team decision-making among participating teachers and administrators.
-- Increased and expanded involvement of the private sector in elementary education which extends beyond the parameters of this particular project.

As an organization, the Corridor Partnership believes so strongly in the collaborative approach that the majority of its programs are structured according to this model. The intense commitment to this idea stems from the realization that, if innovation is to take hold in a school, it must be supported both by colleagues and management.

Other Collaborative Programs of the Corridor Partnership

In addition to the summer training programs for mathematics, science and technology teachers and administrators, collaborative efforts by the Corridor Partnership have resulted in a range of programs for teachers, administrators and students and the involvement of a large number of sponsoring agencies. Figures 1-3 highlight these programs, the needs addressed, collaborative base, perceived benefits and evaluation techniques employed.

The Summer Research Program for Superior Mathematics and Science Teachers, Presidential Awards for Excellence in Mathematics and Science Teaching and Afternoon Scholars programs were developed in response to the needs of business and educators. Two of the Corridor Partnership's programs for high school students received national recognition by the American Association of School Administrators and the COSMOS Corporation. The Saturday Scholars and INTECH were named as exemplary programs as a result of a two-year study by the COSMOS Corporation. Criteria applied to the program included: student and teacher outcomes, emphasis on critical thinking, scientific processes, creativity and innovative use of staff and resources. Evaluators from the COSMOS Corporation visited the programs and reviewed written documents and artifacts.

Saturday Scholars is a unique lecture series for high school students which features distinguished scientists and researchers from national and corporate laboratories, state colleges and universities. Jointly sponsored by the Corridor Partnership and Illinois Bell Education Relations, the lectures offered through Saturday Scholars are attended by more than 1500 students each year. Since 1986, Saturday Scholars has been sponsored by IMSA Office of Outreach.

INTECH, jointly sponsored by the Corridor Partnership and the West Suburban Regional Academic Consortium, provides an innovative science competition for high school students in which young researchers interact with professional advisers from area corporations and universities. This program allows students to work on original research projects under the guidance of practicing scientists, engineers and university instructors. Final projects are judged by teams of scientists. Students compete for monetary awards and scholarships.

FIGURE 1

SUMMER RESEARCH PROGRAM FOR SUPERIOR MATHEMATICS AND SCIENCE TEACHERS

Action Agenda:
- Mobilize resources and actions at the regional level

- Keep good teachers in the profession

Program Description:

Research opportunities are provided to a select group of junior high and secondary school mathematics and science teachers.

Employs approximately 60 teachers each summer for an 8-10 week period.

Needs	Collaborative Base	Benefits	Evaluation
1) Upgrade the teaching of mathematics and science in the region's junior high and secondary schools	Research & Development Laboratories • Amoco Research Center • AT & T Bell Laboratories	For the teacher: Experience and financial renumeration.	By the teacher: Questionnaire By the supervisor:
2) Recognize excellence in teaching	• AT & T Network Software Center • AT & T Information Systems	For the institution:	Questionnaire By the institution:
3) Recognize professional involvement 4) Establish a sustaining network	• Geo. J. Ball Inc. • The Morton Arboretum • Nalco Chemical Company Federal Agencies	Experience, knowledge, and positive attitude the teacher brings to the laboratory.	Interview By the Corridor Partnership: Analysis
	• Argonne National Laboratory • Fermi National Accelerator Laboratory		

FIGURE 2

AFTERNOON SCHOLARS

Action Agenda:
- Restructure the system
- Mobilize resources and actions at the regional level
- Keep good teachers in the profession

Program Description:

A series of workshops for teams of elementary and middle school teachers and their principals which stresses discovery-based learning in science. The workshops are followed by student enrichment programs.

Needs	Collaborative Base	Benefits
1) Upgrade the teaching of science in the elementary and middle school	Research	• Integration of new knowledge and strategies in science
2) Integrate "hands-on," discovery-based learning into the science curriculum	Higher Education Institutions	• Opportunities to work with practicing scientists and researchers.
3) Establish a team approach	Elementary and Middle Schools	• Support for teams.
4) Develop a sustaining network	Government State Level	• Enriched leadership.

FIGURE 3

PRESIDENTIAL AWARDS FOR EXCELLENCE IN MATHEMATICS AND SCIENCE TEACHING

Action Agenda:
- Mobilize resources and actions at the regional level
- Keep good teachers in the profession

Program Description:
An award and professional development program for outstanding mathematics and science teachers in grades 6-12.

Needs	Collaborative Base	Benefits	Evaluation
1) Recognize excellence in teaching	• Professional Organizations	• A sense of appreciation	• By participants
2) Recognize professional involvement	• Government • Higher Education Institutions	• A network with other talented teachers	• By Illinois Council of Teachers of Mathematics
3) Establish a sustaining network	• Business/ Research Laboratories	• A vehicle for program development and publication	• By Illinois Science Teachers Association
4) Improve mathematics and science teaching	• Junior High and Secondary Schools		• By Corridor Partnership

Implications for Improving Public Policy and Economic Development

The business community has come to realize that increased involvement in education at all levels is essential to long-term economic growth. Michael Timpane (1984), Dean of Teachers' College at Columbia University, indicated that "...business leaders have come to understand that the emerging labor supply problem is essentially an educational problem" (p. 389). Structural and demographic changes, the new "information society" that Naisbitt (1983; 1985) eloquently describes in Megatrends and Reinventing the Corporation, are converging the interests and objectives of educators and business leaders alike.

Perr (1988), in a recent issue of Fortune magazine, summarized the dimensions of the business agenda as:

- Restructuring the system
- Mobilizing resources and actions at the regional and state levels vs. the federal level
- Choices
- Lowering the drop-out rate
- Increasing enrollment in post-high school programs
- Recruiting better teachers and retaining them
- Promoting job training
- Supporting pre-school and early education programs
- Inspiring students through involvement of business

Carl Ball (1988), a founding leader of the Corridor Partnership and President and Chairman of the Board of George J. Ball, Inc., an international seed manufacturing and research company located in West Chicago, confirms the continuing need and responsibility of business to be involved in education:

> Industry seeks potential employees who possess highly specialized skills, but it also is interested in finding well-balanced adults who understand how to get along in a variety of situations. And that, as I see it, is what [educators] work to develop in students. I believe we business leaders can help you in this task.

The workforce of the 21st century will be required to have basic competencies in reading, writing and computing plus critical thinking and problem solving skills. Effective communication, cooperation and collaboration in work groups will be needed despite diversity in ethnic or cultural background. Finally, workers in the 21st century will need to be adept at adjusting to change.

The emphasis is the 1980's and beyond into the twenty-first century is on greater involvement of and collaboration between business and education. In the past, business people were active in public school policy and management through participation on school boards alone. The present decade demands a more integrated and innovative approach. The long accepted distinctions between the public and private sector are giving way to the commonalities that bind our purposes together.

Carl Ball (1988), in an address to the Mathematical Sciences Education Board, refers to the Reuben Gutoff 80/20 law which offers a challenging way to think of the relationship between schools and businesses in partnerships. Gutoff's law states that between any two organizations, 80 percent is commonality and 20 percent is difference. Unfortunately, the emphasis generally falls on the differences. One often encounters the response, "But my territory is different" or "My business is different." The Gutoff answer to such a response is a strong, reassuring, "Yes, there are differences. Very strong and key differences. But, there are also very many similarities per the Gutoff rule." These similarities lie in the area of management of business as defined by the American Management Association.

Management involves planning, organization control, decision making and leadership. These aspects of management show a striking similarity between education and business. As Carl Ball (1988) notes:

> We have planning in common--that's clear and attested to by the current wave of interest on the part of school people in strategic planning. We have organization problems--getting and keeping good people throughout the school system is the key obsessive concern of school people as it is business people. Control--We both have the clear discipline of budgets and control of income and expense. Decision-making is a problem for all of us, especially in these days of discontinuity. And finally, who hasn't seen the stamp of leadership exerted on organizations,

whether they're schools, businesses or government. Leadership can really make the difference.

Partnerships provide opportunities for business and education to focus on the commonalities, work together for the common good and develop leadership.

Implications for Teacher and Administrator Education

Participation in public-private sector collaboration in education requires different leadership competencies. If collaboration is the essential base of effective relationships between and among education, business, research and government, then teacher and administrator education must assist educators to develop such competencies. Collaboration is not for the faint hearted. It requires risk-taking, a futuristic perspective, a willingness to innovate and work without set definitions. In a collaborative environment, there are no prescribed organizational charts, no standard job descriptions, no elaborate policy manuals, and no time or place for bureaucracy.

When business people and educators engage in collaboration, they are making a conscious and conscientious choice to exchange traditional bureaucratic practices for the opportunity to embrace a broader vision of excellence in education. The leadership competencies required of teachers and administrators in this collaborative effort are: insight/vision, risk-taking, high motivation and energy, commitment, trust, communication, strategic planning and restructuring/adaptability. Thus, teacher education and administrator education programs must include training in these critical areas:

Change-- In order for systematic and enduring educational reform to be implemented, educators must have knowledge of the change process in organizations.

Collaboration--The process of collaboration requires incentives for educators, deeper shared meaning and mutual respect Educators will require more time and energy for such engagement, an increased flexibility and awareness of human relationships, an ability to deal with ambiguity, a process focus rather than an outcome focus, and a willingness to give up turf or power bases which inhibit the ability to work with people rather than on people.

Leaders who are effective change agents stimulate collaboration through the trust developed between and among independent partners. Communication tends to be authentic. Collaboration begins with an analysis of the problem through multiple perspectives and results in actions need to solve the identified problem. Goals are clarified, and the "big picture" underlying the goals and purposes is clarified by an effective leader.

The power inherent in the collaborative process is used by the leader as change agent with mutual respect. An equitable exchange among collaborators results in visible and mutually enhancing outcomes.

John Dossey (1989), Past President of the National Council of Teachers of Mathematics, suggests a self-checklist for characteristics of leaders as change agent. Dossey believes that effective change agents demonstrate vision, optimism, persuasiveness, "nonflappability", acceptance of responsibility and of criticism, integrative thinking, enthusiasm and an abundance of collaborators.

Leadership in innovative organization structures requires risk-taking, problem solving, and a mandate for action. Alan Kay once remarked, "The best way to predict the future is to invent it" (Digate & Marshall, 1988, p. 68). Collaboration that is focused on a shared agenda for excellence and equity in education provides leaders with unparalleled opportunity to indeed "invent the future."

Research Implications

A survey of the literature describing school/business partnerships makes clear that, with few exceptions, the majority of contributions to the field are essentially anecdotes, testimonials and position papers. A solid research base is required.

The credibility of arguments in support of school/business collaboration diminishes significantly when one realizes that most of the literature is contributed by educators. Therefore, what is needed, especially as the field moves into more mature forms of collaboration, is a data base that more evenly represents the views of business and education.

The need for research in the area of school/business collaboration is evident. Research needs to address complex aspects of collaboration--structure, governance, management, communication, communication barriers and support networks and incentives for individuals involved in the group effort.

Conclusions

This paper presented a model of school/business collaboration, the Corridor Partnership for Excellence in Education. It explored the nature of school/business collaboration and actual program outcomes resulting from this collaborative process in northern Illinois. Educators, business executives and legislators at the local, state and federal government levels need to evaluate how public policy can be changed to result in a better prepared and scientifically literate workforce in the 21st century.

Educators and business will need each other in the challenging years ahead. Schools will need the political clout and technological expertise of the private sector. Business will continue to need educated, enthusiastic young people who can make significant contributions to the economy.

As Walter Massey (1982) suggested, "...we can timidly accept a philosophy that dooms our future growth or we can muster the resources...to forge our future" (p. 9). For the Corridor Partnership for Excellence in Education, the choice is clear.

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The California Partnership Academies

KEITH BUSH

The California Partnership Academies were established in 1980 as a model education-business collaborative designed to improve both educational and employment opportunities for at-risk students. Modeled after the Philadelphia Academies, the California Partnership Academies were conceived with the goal of reducing the dropout rate by providing integrated academic-technical curriculum which demonstrated the relevance and importance of academics and technical knowledge in the workplace. The California Partnership Academies offer an exciting new approach to secondary education. This system has been tested and rigorously evaluated over the past three years.

This paper is organized and presented in three parts: 1) historical background, 2) operating and management structure of a specific California Partnership Academy, the East Side Electronics Academy (ESEA), and 3) recommendations for further research and professional education.

The historical background section of the paper will cover the evolution of the Academy concept from the Philadelphia model to the California Partnership Academies model. Secondly, the paper will describe and discuss a particular model--the East Side Union High School District's Electronics Academy (ESEA). It will map its beginning, evolution, and present status. There will be a discussion of

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the management structure and the operating systems implemented that have made the ESEA program, currently the largest in the state, successful in reaching its goals. The concluding section will address the Evans symposium's issues from the program's point of view with recommendations relating to teacher education, research, and continuing education.

Historical Background

The Philadelphia Academies

In 1969, the Philadelphia Urban Coalition, in conjunction with the Philadelphia Board of Education, initiated the establishment of a prototype industrial academy for the career development of inner-city youth. Many of these youth did not qualify for admission into the city's established vocational schools. That prototype, know as the Academy of Applied Electrical Science, Inc., was begun in 1969 as The Philadelphia Urban Coalition's response to the conflicts that emerged during the 1968 riots. Two more academies were added: a business one in 1972, and an automotive one in 1975. This initial collaboration between the societal institutions of work and learning laid the foundation that made the Academy concept such a unique contribution to education.

The California Peninsula Academy

In 1979 a planning grant was given by the California Department of Education to the Sequoia Union High School District. The Sequoia District is located in Redwood City, California, which is on the peninsula approximately halfway between San Francisco and San Jose, near "Silicon Valley." The planning grant was intended to replicate the Philadelphia Academy concept. The grant was developed jointly by Sarita Berry, Executive Director of the Stanford Mid-Peninsula Urban Coalition, and Dr. Harry Reynolds, Superintendent of the Sequoia District. Berry brought together Dr. Reynolds and John Young, the president of Hewlett-Packard Co. who was a member of her Stanford Mid-Peninsula Urban Coalition Board of Directors. Young and Hewlett-Packard Co. have become one of the Academies' major industry sponsors. The support and foresight of these key individuals got the "Academy" model started in California.

The existing technical and career-vocational programs in the Sequoia District educated large numbers of high school students and were characterized as traditional in nature. Data revealed that many students, particularly those who were disadvantaged, high-risk and from low socio-economic backgrounds, were not being served effectively.

During the planning year and subsequent implementation years, the fundamental elements of the Academy were developed. These elements consisted of the involvement of business and industry in the process of public education. The model established a school within a school structure at two of the district's high schools, Sequoia and Menlo-Atherton. Both schools have a minority enrollment of from 25% to 30%, composed primarily of students who are Black, Hispanic, Asian or Pacific Islanders.

The Peninsula Academy design provided for a core education program that was linked to a career-vocational theme. The model was also designed to be responsive to the needs of both disadvantaged students and private industry.

The initial program's objective was to involve students in a meaningful, high quality career-vocational education experience that would not only address students' academic skills, but would also motivate students to continue their education until graduation from high school. A secondary objective was to ensure that each student would achieve required levels of competency in basic academic and technical skills, along with developing interpersonal skills and other work related abilities.

The business and industry community supported the program through financial contributions, loaned instructors and personnel to serve as mentors and advisors, after school and summer jobs, visiting speakers, student tours of local companies and equipment. The companies, in conjunction with the Urban Coalition, also provided instruction of employability skills.

The management structure for the academies evolved during the first years of implementation. At first, the Urban Coalition took the lead in directing the program and bringing together the industry and school partners. An executive committee, acting as a policy board, and a steering committee, dealing with day-to-day issues, were formed. Both industry and the schools were represented on these committees.

The Coalition also brought representatives of the corporations and schools together to form planning and curriculum committees. An outside firm, the American Institutes for Research, was engaged to provide program development and evaluation assistance. This third party evaluation process has proven to be one of the key elements in the success and development of the California Partnership Academies. Based on the innovative program proposal, the Sequoia District received sponsorship from private foundations (initially the David and Lucille Packard Foundation and the San Francisco Foundation), from corporations, and from local, state, and federal programs. The funds were used to support the development and evaluation of the initial Peninsula Academy.

The first Peninsula Academies class was recruited in the spring of 1981; and, in September 1981, 91 tenth graders entered the program at both schools. By the fall of 1983, a full three-year program was in operation, with a total of 184 students enrolled in grades 10 through 12. Peninsula has now graduated five classes and remains the "Mentor" to the newer academies. It should be noted that as the Peninsula program has evolved, the leadership and responsibility for the program has shifted from the Coalition to the schools themselves, as the Academies have become an integral part of the district's program.

In 1984, the California legislature voted to establish up to ten replications of the Peninsula Academies. In the fall of 1985, after a year of competitive selection and program planning, ten Peninsula Academy programs were launched. These academies were located throughout the state and employed such career themes as: health careers, food service and hospitality, finance, computers and electronics. More than 530 tenth grade at-risk students were served in the initial year of operation (1985-86).

A comprehensive evaluation was mandated in the initial authorizing legislation for the Academies. The 1985-86 evaluation study was conducted by the Policy Analysis for California Education (PACE) group and revealed several important findings: (a) the average retention rate in high school among students in the academies was 83%, while among the comparison groups at six sites it was 75%, (b) the mean number of credits earned for Academy students was 53.5 (up from 48.7 in 1984-85); for comparison groups it was 40.3, and (c) Academy students' self-esteem and attitude toward school improved significantly (Dayton, Reller and Evans, 1987). Based on the results of the evaluations and the popularity of the Academy model, 18 California Partnership Academies were in operation statewide by 1988-89.

Managing an Academy Partnership

This section will focus on one of the California Academies currently in operation. This view of the operation of the East Side Electronics Academy (ESEA) is fairly typical of the challenges, procedures, and structures used at the other sites throughout California.

District Overview

The East Side Union District is the largest 9th grade-adult school district in the state of California. The district has 11 comprehensive high schools with 22,500 high school and 17,000 adult students. The district covers a large part of San Jose and parts of neighboring communities; the district is surrounded by "Silicon Valley," which was the inspiration for the electronics theme for the Academy. Unemployment is generally below the state and national levels.

The student population is culturally diverse. Minorities comprise approximately 70% of the district and the ESEA program. Hispanic students represent approximately 40% of the districts enrollment, while Black and Asian students comprise 22% and 10% of the population respectively. In addition, 13.4% of the students come from families receiving AFDC subsidies.

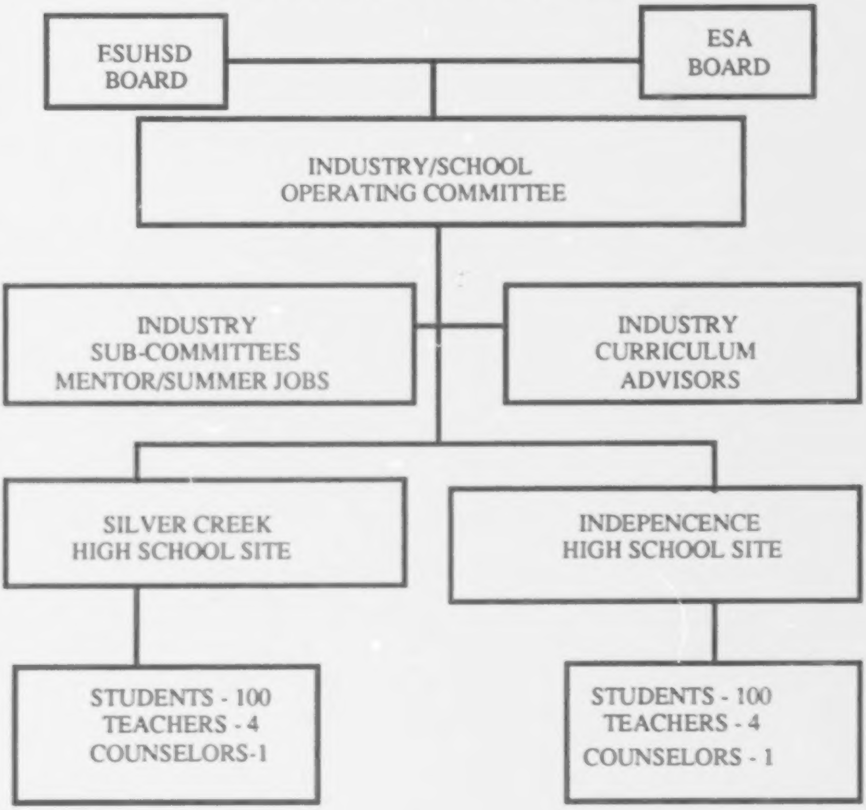
Academy School Sites

Silver Creek High School's architecture is fairly typical of California's suburban schools, with a sprawling one-story campus. Independence High School is part of a larger "Educational Park" setting which includes a planetary, a major branch of the city's public libraries, public health office, impressive athletic facilities and other amenities which can be justified for a school of its size. Its current enrollment is just over 4,000, making it one of the biggest schools in the state. Silver Creek's enrollment is approximately 2,400.

The district has an annual drop-out rate of 35-40%. Students who drop out are severely disadvantaged in the high technology world of work for which they are not prepared. By working in the impersonal atmosphere of a large comprehensive high school, many students appear to develop patterns of under-achievement, habitual truancy

FIGURE 1

Organizational Chart
EASTSIDE ACADEMY
INDUSTRY/SCHOOL PARTNERSHIP


ESUHSD BOARD
ESA BOARD
INDUSTRY/SCHOOL OPERATING COMMITTEE
INDUSTRY SUB-COMMITTEES MENTOR/SUMMER JOBS
INDUSTRY CURRICULUM ADVISORS
SILVER CREEK HIGH SCHOOL SITE
INDEPENCENCE HIGH SCHOOL SITE
STUDENTS - 100
TEACHERS - 4
COUNSELORS-1
STUDENTS - 100
TEACHERS - 4
COUNSELORS - 1

FACTS:
Participating companies have top level support
Each participating firm has a company lead contact
Companies participate with personnel, funds and equipment

and inappropriate behavior. These under-achieving students have enormous difficulties realizing their personal goals in schools with large enrollments, rigid departmentalized structures, and decreasing support services.

The Academy model provided an alternative solution to the problem. It provided a supportive group of teachers and peers, a challenging and relevant curriculum, and close ties between the private sector and the school.

Program Development

The ESEA originated as an initiative by the Superintendent, Dr. Harry Reynolds, who happened also to be Superintendent in the Sequoia District when he helped found the Peninsula Academies. The ESEA became a priority for the district.

The program is managed by the district's Career Services Administrator. The ESEA had a year of planning time in which the decision was made to develop the Academy model without the assistance of the Urban Coalition. It was felt that the district had sufficient ties to its local business and industry community to establish the support necessary without the help of a third party.

With the help of Hewlett-Packard and IBM Corporation top management, a coalition of electronics companies was recruited to support the program. Each company appointed a "lead contact" for the company that would work with the program manager to help provide the necessary resources for the planning, implementation and operation of the program. Both ESEA programs are managed and coordinated from the central office but located in two different high schools.

This office, which also manages the district's career-vocational programs, is supported by a full-time "Loaned Industry Liaison" who is an employee of one of the participating industries, and coordinates with the program manager and the school sites to insure the necessary business and industry resources are in place.

Management Structure

Business support for the Academy program at the two schools is centralized through a committee structure (see Figure 1) that includes: 1) a board of directors which meets twice a year and includes the district superintendent and high-level business executives. 2) a management committee, whose members are equally divided between ESEA, school personnel and upper-level business executives, which meets monthly and is chaired by a business person, and 3) sub-committees for industry mentors/summer jobs, and curriculum advisors. These sub-committees are coordinated through the "Loaned Industry Liaison" (see Figure 2).

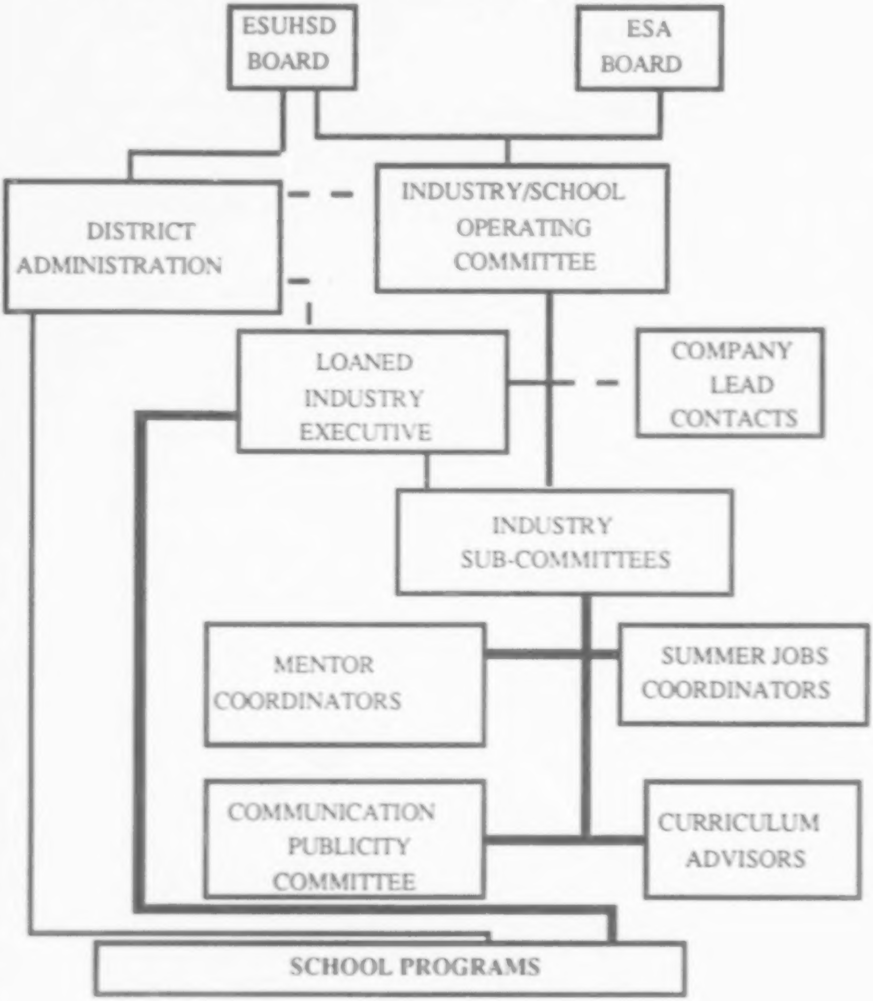
To date, the experiences of the ESEA suggest that industry and education operate in two separate cultures that seem to have a hard time relating to each other's way of thinking or doing business. This partnership problem has been bridged by having an industry employee working with and coordinating industry volunteers. The "Loaned Industry Liaison" reports to the Operating Committee and receives day-to-day direction from the district ESEA Program Manager. The Loaned Industry Liaison and the Program manager jointly handle complicated logistics relating to either business or educational operating policies/procedures.

This arrangement has simplified the industry participation process by providing a single source/office/person through which various industry volunteers can communicate. This person, who understands the "industry way of doing things" works with ESEA teachers and students to again help bridge this perceived cultural gap and create the "partnership". Clearly, this process is a two-way street: not only do the educators learn about the "industry way of doing things" but the industry volunteers gain an understanding of the "educational way of doing things."

During 1988-89 more than 150 industry volunteers worked with the ESEA in various capacities. The Mentor Program alone has 112 volunteers with 115 mentees and 15 mentor coordinators at each of the participating companies. The summer and senior jobs program has a similar structure. In the summer of 1988, the first summer jobs effort, 47 students were placed in responsible positions with our participating companies. The curriculum advisors work with the various subject area ESEA teachers from each site to review the material that needs to be covered and to provide practical application and/or learning experiences for the teachers that will enhance their teaching. During summer workshops and meetings throughout the school year, the curriculum advisors help the ESEA teachers divide each of their subject areas into sequenced weekly units of instruction.

STRUCTURAL CHART FIGURE 2

EAST SIDE ACADEMY
INDUSTRY/SCHOOL PARTNERSHIP PROGRAM


ESUHSD BOARD
ESA BOARD
DISTRICT ADMINISTRATION
INDUSTRY/SCHOOL OPERATING COMMITTEE
LOANED INDUSTRY EXECUTIVE
COMPANY LEAD CONTACTS
INDUSTRY SUB-COMMITTEES
MENTOR COORDINATORS
SUMMER JOBS COORDINATORS
COMMUNICATION PUBLICITY COMMITTEE
CURRICULUM ADVISORS
SCHOOL PROGRAMS

These units provide concepts which are interrelated, whenever possible, to facilitate student understanding in electronics, math, English and science courses. Curriculum advisors also teach units at the school sites and provide opportunities in appropriate industry training programs for both students and teachers to observe operations first hand.

At both high schools, Academy students are enrolled in English, math, science and electronics in the morning four-hour block of time. This schedule gives the Academy the flexibility to go on field trips, hear guest speakers, or work with mentors without missing other classes. ESEA students take other non-Academy classes (e.g., physical education, health, social sciences, music) the rest of the day.

Funding

Programs like the ESEA's require "extra" funding. The instructional programs ties with the industry partners are labor intensive and costly. The equipment and the additional support materials needed to address this "high-risk" group of students will cost more than those resources provided for the traditional comprehensive high school program. The California Partnership Academies and ESEA have gone through several phases of funding.

Initially, the ESEA financed its planning through independent grants from the Hewlett and Hancock foundations. Additional funds were donated later on from some of the initial sponsoring companies. During the 1985-86 school year the California Assembly enacted a three-year bill providing a $50,000 grant to each Peninsula Academy replication site, including the ESEA.

In the fall of 1985, a consortium including industry and State Department of Education representatives began working with local state legislators to develop a consistent funding base for the Academies program. Senate Bill 605 was passed in 1987 and provides for performance based funding for the Academy model. According to the bill, any Academy program which has been approved through the competitive application process must have:

- A student selection process designed to enroll students with academic potential, but whose past performance indicates they are in danger of dropping out of school,
- A full school-within-a-school structure, such that Academy students in grades 10-12 enroll as a group for three years in

three core academic subjects, including English and mathematics,

- A technical course in grades 10-12 designed to provide students with basic job skills in a promising labor-market field,
- A program that is taught by teachers who have a common preparation period during which they can coordinate their activities and curriculum,
- Support from local businesses, including curriculum development, guest speakers, field trips, mentors, and work experience positions,
- Both high school and district support for the program, providing the necessary teacher preparation time, facilities, curriculum development, and counseling support.

In addition, the program must verify that each student:

- Met at least three of the four high-risk factors, which included: 1) poor attendance 2) low motivation 3) low performance 4) economically disadvantaged background,
- Has an 80% positive attendance,
- Has passed 90% of the required credits.

Through the performance-based funding arrangement, each program can earn up to $67,500 per year. The funding varies depending on performance of the program.

Industry Participation

Establishing and maintaining this part of the partnership can be one of the hardest and most complex tasks. Initially, companies must be made aware of the benefits of participating in the partnership.

Most companies in the San Jose area have corporate goals relating to community involvement. When companies are contacted regarding the ESEA, the points stressed are that the:

- Company can directly impact the quality of the future work force,
- Employees develop a strong sense of pride in their company because of its commitment to improving education, especially if it's in the areas where a majority of the companies' employees live,

- Companies that show active support for programs are in compliance with federal Affirmative Action guidelines,
- Companies are providing training for minorities and other groups protected by Affirmative Action,
- Companies may receive a tax credit for hiring qualified youth.

Sharing the results of the program evaluations also aides in recruiting new companies. Participating companies review this evaluation annually to reaffirm their participation.

The experiences of the ESEA suggest that there are several key factors in working successfully with industry partners: 1) keep the partners involved, 2) make sure there is shared decision making, 3) reward volunteers, 4) report progress and successes, and 5) get the decision makers involved with the students.

Staff Development

In developing education-business partnership programs two basic challenges that need to be addressed from the staff perspective are that: 1) teachers have not received training in working in teams or groups where shared decision making is done, and 2) most of the academic teachers have not worked in business or industry. Consequently, they do not understand the "work world culture," which makes it hard to teach about employability skills or relate academic instruction to the applications found in the business and technological world.

A key ingredient in an Academy program is to have a team of teachers, counselors and administrators who work as a team and participate in shared decision making. Often these challenges are not envisioned in the beginning. It was expected that the team of teachers would be able to work as a cohesive group and make shared decisions.

It was discovered quickly that teachers have been trained to work on their own and are used to operating autonomously in a high school classroom. In general, teachers have not received training in teamwork. Teachers from such diverse areas as English, math, science and industrial/technology education have not been prepared to interrelate their instructional units, make joint decisions on curriculum sequencing, select student activities, or develop instructional units for teaching employability skills in a business field.

To address these staff development needs, the industry partners were asked for help. It was quickly learned that these companies had faced similar problems when they created new work units/teams; and that they had developed sophisticated training programs to teach the specific skills needed for teamwork and shared decision making. Two of the participating companies provided their instructors to train staff in the "Working in Teams" techniques.

Since several of the academic teachers had no understanding or experience in the "other world of work," a summer mentor/shadowing program was developed. Teachers were matched up with industry volunteers (teacher mentors), usually in an area related to the teacher's subject area. Teachers spent time shadowing workers in a variety of different jobs. The primary objectives were to give teachers an understanding of the different skills that their students would need to develop and to help them understand how a company works. Teachers were also able to identify many practical applications of academic content that could be adapted to their curriculum.

Recommendations

A number of substantive recommendations can be drawn from the first three years of operation of the ESEA and the California Partnership Academies. Overall, this model education-business collaborative offers several important alternatives for at-risk students. The ESEA is particularly effective with the growing plurality of students in high school who are not working up to their potential and who need an educational program which combines academics, technical education, and a peer and teacher support group.

Evaluations of the Academy model by independent groups, often involving the use of comparison groups, suggest that the California Academies have been highly successful. The most recent studies suggest that the Academy model enhances students' self-esteem and engenders a positive attitude toward school. Additionally, the Academies appear to increase student retention in school, attendance rates, cumulative grade point averages, and credits earned. (Dayton, Reller & Evans, 1987)

Additional evaluations are needed to monitor the long range effects of participation in the Academy programs upon participants' employment patterns, earnings, and further education. The extent to which the Academy programs enable at-risk students to remain independent from welfare programs is also a critical issue. As the nation's population of at-risk students continues to expand in size, the effects of the Academy model on new groups of special students (e.g. students with limited English proficiency) should also be examined.

The implications of the Academy model for reform in teacher education and professional development in the schools are rather obvious. Universities and colleges must prepare teachers who have clear understandings of how to work in teams at the secondary school level. All academic and vocational-technical teachers must have skills in developing and teaching integrated academic-vocational curricula. Additionally, high school teachers should have several opportunities to observe and shadow individuals in the private sector on a regular basis. Such internship experiences for teachers are vitally important in helping teachers develop new insights into the rapidly changing world of work. Clearly, the capability of teachers to work collaboratively with each other and local industry partners is central to the success of partnership efforts.

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Corporate Collaboration as a Catalyst for Teacher Education Development

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This paper examines the Math English Science Technology Education Project, MESTEP, as a model for preparing new teachers using collaboration between public school systems, high technology firms, and the University of Massachusetts at Amherst. Since 1982, MESTEP--a combined fifth year certification and master's degree program--has recruited, prepared, placed and retained in public school teaching 123 talented arts and sciences graduates.

A hallmark feature of MESTEP includes semester-length paid internships in public school and corporate education settings. While teaching, MESTEP students follow a normal school schedule with two or three separate class preparations, study hall and cafeteria responsibilities, and, in some cases, extracurricular duties. During their corporate internships, participants develop educational software, edit textbooks, teach in industry education programs, or design new approaches to information management. After performing service roles in corporate settings, and using computers and other information technologies routinely in their work, MESTEP students report changed perceptions and new understandings about curriculum and instruction, technology in schools, and themselves as teachers and learners.

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We begin by examining MESTEP and how it has sustained public-private collaboration by generating "interactive partnerships" (Jones & Maloy, 1988) among individuals and organizations. Next we review the experiences of MESTEP students during the Project's corporate internship. Finally, we offer some thoughts about how ongoing planning and problem-solving among educators and industry participants can contribute to a process of teacher education more relevant to an emerging information society.

The Math English Science Technology Education Project

MESTEP was initially conceived in 1982 as the Math Science Technology Education Project through conversations between a school superintendent and a University faculty member who had been colleagues for a decade. They agreed that schools needed to attract and retain talented teachers. They recognized that college undergraduates majoring in science and mathematics represented a pool of potentially excellent teachers. They also recognized that the private sector was competing very effectively for the same group. By January 1983, a school-university-corporate partnership had formed to design and implement a program to attract college arts and science graduates into teacher education and teaching.

A fifteen month clinically-based Masters of Education (M.Ed.) program is at the core of the MESTEP model. Prior to the start of classes in June, college seniors and recent college graduates from across the country are selected from about 100 formal applications. They are invited to Massachusetts for one of two day-long interview sessions. Candidates meet with representatives from participating school systems and companies who are recruiters for MESTEP and for teaching. School and corporate personnel make judgments about a candidate's academic and personal background, interpersonal skills and potential for success in school and industry settings. Combined school-corporate interviews also offer prospective students an opportunity to assess whether they want to pursue certification through the MESTEP model.

During the first summer of the program, 25 enrollees spend one month at the Amherst campus of the University of Massachusetts working closely with University faculty and public school personnel doing microteaching and taking courses designed to explore the work of middle and high school teachers. The program then moves to the eastern part of the state where candidates participate as staff members in a summer school offered by the Acton-Boxborough (Massachusetts) Public Schools. They teach in the mornings, plan instructional strategies and develop curriculum materials during the afternoon, and interact with public school personnel who serve as mentors and master teachers.

During the academic year MESTEP participants spend alternate semesters in full-time paid teaching and corporate internships. Each teaching intern assumes the responsibilities of a regular teacher and is supported by on-site mentor teachers and University supervisors. In company settings, interns work primarily in the educational services divisions. Internships are designed to show prospective teachers how companies work, how they train or educate, and how they apply technology in these processes. For example, interns might be involved in evaluating courses for a sales training group; designing and delivering training modules; developing telemarketing campaigns; setting up a local area computer network; editing instructional materials; or conducting research about hazardous wastes.

During the second summer all students return to Acton to complete their M.Ed. course requirements. The summer provides an opportunity for the group to discuss the concerns, challenges and strategies facing beginning teachers. This time together also serves as an opportunity to add to and share the resources that the interns have accumulated during their school and industry placements; to expand their knowledge of educational technology; and to complete job searches for September.

The success of MESTEP is demonstrated by its record of preparing, placing and retaining its graduates in teaching. Over six years, all 123 candidates have completed the program in the following subjects: Mathematics (46); English (12); Chemistry (14); Physics (17); Biology (19); and General Science (15). Eighty-two percent of those individuals currently continue to teach. A goal of recruiting minorities into teaching has resulted in 23 percent minority representation among MESTEP students.

Now in its seventh year, MESTEP has assembled a network of its graduates, 50 public schools, 15 corporations, a dozen mentor teachers, and hundreds of cooperating public school and business staff members. Participating school systems include: Acton, Lawrence, Boston, Brookline, Framingham, and Concord. Companies include: Digital Equipment Corporation, IBM, General Motors, New

England Telephone, GTE, Bank of Boston, Hewlett-Packard, Houghton Mifflin, and Boston Museum of Science. In addition, the Massachusetts High Technology Council and the Boston Private Industry Council have contributed actively to the development of the Project. The Fund for the Improvement of Postsecondary Education has supported recruitment and follow-up interviews with graduates. MESTEP received the 1987 Distinguished Achievement Award from the American Association of Colleges for Teacher Education. In 1988, the project was cited as an Exemplary School/University/Industry Partnership by the Massachusetts Department of Education.

An Interactive Partnership for Teacher Education

MESTEP functions simultaneously as a new teacher education program, a school/university collaborative, a minority recruitment effort, an alternative certification option, a teacher support system, a staff development project, a high technology network, and a data base for research. In so doing, MESTEP has redefined traditional notions of education-business collaboration and implemented new structures for preparing teachers for the 21st Century.

As a complex collaboration, MESTEP's ability to foster interorganizational activities that support new roles and alternative structures has promoted its success over time. Byrd Jones and Robert Maloy (1988) have defined collaborative activities that generate new individual and organizational behaviors as "interactive partnerships." Such interactive school improvement relationships involve more than simply exchanging resources or delivering a service and then assessing its success or failure.

> Cooperation is generated by the movement of ideas, resources and people back and forth between organizations. Goals and objectives are not specifically defined in advance, but emerge and shift as the partners negotiate the terms of their mutual efforts. As an approach to educational reform, such partnerships are practical, cost-effective and highly promising. (Jones & Maloy, 1988, p. 11)

Current research on school change has demonstrated the complexity of introducing collaborative problem-solving processes into public-private partnerships (Sarason, 1982; Sirotnik & Goodlad, 1988; Trubowitz et al, 1984). To date, most educators have sought outside partners who are willing to supply schools with additional resources. Businesses and other organizations have responded to this "you have/we need" approach by donating computer equipment, volunteers for tutoring, training materials for teachers, speakers, field trips and other low-cost "extras to schools." Yet, donations of equipment and personnel time do not, in and of themselves, create meaningful partnership between schools and outside organizations. "Those interchanges seldom evolve over time, engage only a few individuals, respond mainly to surface problems, and rarely touch the underlying ethos of participating organizations" (Jones & Maloy, 1988, p. 6).

"You have/we need" exchanges are part of the practicum or field experience component of most university teacher education partnerships with public schools. Cooperating practitioners agree to allow a student teacher in their classroom in exchange for help and the opportunity to pursue their own professional development by using university-sponsored tuition waivers. However, "as internships become routine, few people at the school or university level recall how and why the original arrangements were established". While the system may function smoothly in many cases, "deeper questions about what constitutes an optimal mix of classroom and field experiences seldom arise" (Jones & Maloy, 1988, p. 127).

New Roles for Corporate Partners

MESTEP's interactive framework encouraged teachers, higher education faculty and business professionals to promote new structures for preparing teachers. "As a small project with a distinct identity, MESTEP could test new arrangements, tap new sources of potential teachers, and introduce new behaviors within all three organizational cultures" (Jones & Maloy, 1988, p. 127). Recruiting talented college graduates into teaching; planning and conducting a teacher education partnership; and using corporate internships to broaden thinking about teaching and learning among secondary certification candidates are three examples of new structures that have been developed by the MESTEP collaboration.

First, promoting interorganizational cooperation through new roles for school and industry personnel has positively affected MESTEP's recruitment efforts. Schools and companies have been asked to do more than just provide paid internships for Project participants. For example, corporate and school system recruiters distribute MESTEP literature, interview all candidates, and play central roles in admission decisions. Candidates moving to Massachusetts find apartments through corporate partners' employee assistance offices. Technology courses are designed and taught by school, corporate and University personnel using industry-donated computers in school and corporate computer laboratories. Teachers and industry personnel act as mentors and supportive colleagues during internships.

The program has produced great interest among graduating college seniors--on average over 1000 people inquire about the program every year and MESTEP receives three to four times more applications than openings in the program. Applicants have listed their key reasons for considering MESTEP: intensity of the program, immediate teaching responsibilities, linkages to industry, and paid internships (Clark & Fischetti, 1987)--all possible through collaborative responses to the recruitment goal that include multiple levels of participation by all partners.

Second, joint participation in recruiting has allowed the planning and development of the project to emerge in new ways. From the outset a Planning Board composed of five University faculty members, five school superintendents, and four corporate managers has served as a planning and policymaking body for MESTEP. Initially, the Planning Board focused on developing a base of support for the project within schools and high technology firms. Digital Equipment Corporation's commitment to hire all interns the first year and the decision of the University President and School of Education Dean to allocate funds were instrumental in getting the Project started.

Collaborative management of MESTEP has included a sustained focus on teacher education and school improvement. Shared decision making, a record of positive accomplishments and a sense that each participant has important contributions to make has helped retain commitment and enthusiasm among original partners while allowing new individuals and organizations to join the Project. Committed partners, multiple sources of leadership, extended support networks, evolving activities and relationships, and mutual trust among participants have given rise to a climate of interorganizational cooperation that fosters exploration and experimentation (Jones, Clark, Maloy, & Fischetti, 1989). Over time, MESTEP has increased efforts to recruit more minority applicants, redesign teacher education curriculum, develop the summer school, and expand the technology education component of the Project.

Experiences of MESTEP students in corporate internships are a third part of the Project where interactive exchanges among partners promote activities and outcomes rarely found in more traditional teacher education arrangements. As part of the requirements for the industry component of the project, MESTEP students have been asked to reflect in writing about their activities in corporate settings. We analyzed seminar papers to identify how exposure to industry influenced the thinking of students about curriculum and instruction, technology in schools and themselves as teachers and learners. Content analysis of student writings was supplemented by interviews and observations of interns in school and corporate placements.

MESTEP Students in Corporate Settings

We summarized the comments of MESTEP students about their experiences under three general themes: (a) thinking about teaching and learning in schools: effective curriculum and instruction, the importance of educational environments, and how students learn; (b) expanding understandings of the world of work: how high technology firms operate, the influence of corporate cultures, and encounters with new technologies; and (c) developing new personal skills and professional competencies: working in groups, individual growth, and reaffirming the decision to teach.

Thinking about teaching and learning in schools

MESTEP students repeatedly connected their corporate activities with their thinking about particular components of school curriculum or instructional activities. After teaching GED courses at a General Motors plant, one intern appreciated "the time and effort needed to design and implement a course." While setting up a computerized database for use by marketing representatives, a physics major observed that "effective interaction with other people is the most important aspect of being a teacher." Participants found that their experiences caused them to reassess what should be the appropriate content of academic courses. As intern working as a corporate course evaluator urged schools to eliminate or update material as a way to "prevent some of the standard student grumblings 'that this class is stupid' or 'why do we have to take this'." After helping identify priorities for education and training at one firm, another intern commented that "needs analysis is an extremely valuable skill, useful in determining students' educational requirements in order to provide individualized instruction."

Interns expressed the need to individualize their teaching to meet the needs of students. A member of an office applications training group said "our courses often have misplaced students that learn at a faster or slower pace than do the other students." To train company personnel in the use of VAXmates, an intern "had to switch to a less formal training approach. This approach can be applied directly to high school physics teaching, if I can find physics to teach in things that the students would be doing anyway." And English major realized "there are many 'diamonds in the rough' out there ... to help them discover a new and powerful side of themselves is a job and a privilege."

MESTEP students found that the educational environment is a vital part of the teaching and learning process. One observed that an "intimate classroom setting of approximately 8 students allowed me to focus more fully on individual learning styles and helped me sharpen my abilities to analyze student learning and comprehension." A second remarked how "the frenetic pace of the course. . . has been frustrating for the people who need to learn basic skills in a relaxed, non-threatening environment." A third remembered that "creating a trusting, non-judgmental class atmosphere was the most difficult part of teaching."

Many interns shared their sense that having to perform unfamiliar jobs in new setting caused them to reexamine their assumptions about what it means to be a student. After teaching a course on writing skills for engineers and scientists, an English literature major believed that he could "more readily appreciate the vast disparity of interests in any given group of people." Recalling her difficulties in becoming acclimated to a corporate environment, one woman stated "I know and understand well how frustrating and confusing it can be not to have a clear handle on what one's role is in a certain situation."

Another recalls the manufacturing workers in her classes "citing examples of teachers who did not respect them as people, humiliated them, or ignored them." After teaching dBASE a MESTEP student concluded:

> if students are not provided with a practical opportunity to use their new knowledge fairly soon after acquiring and mastering

it, it may not only be lost, but considered meaningless. Let this happen a few times in a row (or over several years) and it's no wonder kids don't want to pay attention in class and are more concerned with what their best friend is wearing that day than the algebra being done at the board.

Expanding understandings of the world of work

MESTEP students reported learning more about how high technology firms operate within the American economy. Once familiarized "with the business world and its day to day functioning," an undergraduate physics major felt it "especially important for teachers to know how ideas and theories are used in the real world." Another science major believed his experiences "will enable me to serve as a better resource for my students when they ask questions about how high tech industries function."

Students in some corporate placements initially questioned how their work connected to teaching in schools, particularly when their jobs involved noninstructional activities such as survey evaluation, database design or textbook editing. Eventually, most linked their experiences to educational responsibilities. Noting that "teaching is largely a self-directed and autonomous task, my experience at IBM this semester in a self-directed environment will benefit me in my teaching."

For some interns their corporate experiences were not all positive. Comments included: "I caught a glimpse of the competitiveness of industry." "Everyone was speaking Digital-ese." "What I've observed is that the people who feel they have to impress, who are trying to 'move up,' or sell themselves are the 'best dressed'." "I also expected to see much more of a 'team' atmosphere. What I found was a bureaucracy much like the government and school bureaucracies I have worked for in the past."

After using computers and other information technologies regularly during their internships, MESTEP students felt their technological horizons had been extended. One individual "worked with the computer everyday and really increased my skills." One candidate who had never used a computer before joining MESTEP stated that "overall I feel very comfortable working with a computer and I have learned how valuable they can be when used properly." Another was pleased with the "intense exposure I received to computer systems and software packages."

Some interns moved beyond basic competencies with technology while in industry settings. Commenting on his experience with the computer-aided learning program, PLATO, an intern saw "computers as a tool to be used in the attainment of our highest educational goals--creative thinking; responsibility (to oneself and others) for learning--for growth and development; and critical analysis (the ability to evaluate information) coupled with an open mind."

Using a Macintosh computer in a book production process showed an intern that "familiarity with a Mac is going to be generally useful. After reviewing software sold by a major vendor, a physics graduate commented that it was "primarily tutorial in its approach, relying on recall and short-term retention rather than using a discovery or demonstration format for teaching concepts."

Developing personal skills and professional knowledge

MESTEP students reported that improved writing skills, increased communication skills, knowledge of how to work with a variety of personalities, and greater personal confidence were important outcomes of time spent working in corporations. An English major "realized the quality of being an effective communicator is essential for survival, not only in business interactions, but also in social interactions." Another found "critical thinking skills, problem solving skills, logical thinking skills, and skills in working with people are necessary in the corporate world." A third participant "discovered abilities (in myself) that have never surfaced before." Another student saw that "in the past five months there has been a re-emergence of an aspect of myself; me wanting to ask questions."

After completing their internships, participants described working in groups as a key learning experience. One appreciated the "spirit of respect and cooperation that exists between colleagues." A second found that teamwork "fits right in with one of the intangible factors that I want to bring to my classroom: a mutual feeling of respect between teacher and student, and more importantly, between student and student." After co-workers acknowledged his comments in a meeting, a third intern remarked "the message came through so clear that it almost knocked me down: I have to give that support and respect to my students."

MESTEP students also commented on the experience of "learning by doing." Starting an internship at one firm "meant scrambling around for the first few weeks learning where everything is, who everyone is, and figuring out the VAXmate." Teaching a class on "Achieving Excellence" to middle-level managers led one science major to comment: "I am less apt to think changes cannot be accomplished and more directed now to identify what is not working and move to correct it." One woman discovered "a sense of confidence that, placed in anything, I will be able to make some sense of it in a reasonable amount of time."

Repeatedly, experiences in corporations served to reaffirm for MESTEP students their decision to pursue teaching as a career. One stated that "while the corporate environment has some advantages, and while I felt successful at what I did, I never felt the same fulfillment that I got out of teaching kids." Another felt "the challenge of developing relationships with kids and the job of seeing them grasp a new idea or concept has not been matched here."

For others, the choice to teach was connected to an increased sense of professional competence. One science major felt "this industry internship gives me a chance to say, 'I am competent elsewhere but I have actively chosen a school-teaching role in society'." Another remarked that "knowing that I have the capability to work in other settings helps me to know my decision to teach is one of desire to do nothing else, not the inability to find or do anything else." A third "really liked the amount of responsibility that I was given at the bank but . . . missed the constant interaction with people."

Conclusion

Since 1984, the Math English Science Technology Education Project has used public-private collaboration to implement an innovative, evolving approach to the preparation of new teachers. What lessons can public school personnel, university faculty, business leaders and other interested outsiders gain from MESTEP's experience?

First, collaborative planning and problem solving have enabled MESTEP to redefine many elements of more traditional teacher education programs. School, university and business partners construct MESTEP logistically and programmatically by playing active roles in designing, delivering and improving the operation of the program. By replacing a one-way exchange model of collaboration with a series of interactive processes, MESTEP can "establish a substructure that can make decisions (governance), sustain activities (management), and renegotiate evolving processes (leadership)" (Jones & Maloy, 1988, p. 126). Innovation and change is promoted within the largely stable organizational settings of schools, universities and companies.

Second, corporate internships not only give business partners active roles in teacher education, but also provide new teachers with firsthand opportunities to experience changing jobs and emerging technologies. Candidates see new production processes in firms; learn how high-technology, multi-unit organizations work; and encounter organizational cultures that are different from those of schools. Working in teams, problem solving on-the-job, and utilizing new technologies in production or information transfer, MESTEP interns learn and use the skills their students will need to succeed in our rapidly evolving service economy.

Third, teacher education students in MESTEP report new understandings about teaching and learning as an outcome of time spent in corporate settings. Some interns have thought about their personal learning styles and most seem ready to reassess how adolescents in secondary schools learn new skills and overcome prevailing uncertainties and fears. Playing new roles and developing new relationships has been shown to foster personal growth and development (Bronfenbrenner, 1979; Kegan, 1982). Placing future teachers in unfamiliar settings as part of their professional preparation helps them to rethink their own assumptions while encouraging professionalism and self-accountability.

Fourth, learning through work experiences in companies is but a first step in the development of an understanding of technology for teacher education candidates. Exposure to technology alone may not alter how new teachers think about its use in schools, just as collaboration through one-way exchanges of people and resources does not necessarily produce meaningful educational change. As one observer noted, "transforming classroom practices through the computer stretch well beyond what many teachers view as possible. . ." (Cuban, 1986, p. 81). School, university, and business partners must continue to develop opportunities for teacher education students to transfer their own use of computers, telecommunications, intelligent tutoring systems and other interactive software into classroom applications.

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University-Corporate Collaborative Relationships in Continuing Engineering Education

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ANNE COLGAN

The purpose of this dissertation study was to investigate collaborative relationships between businesses and universities in the provision of continuing engineering education. While continuing professional education can include a broad array of purposes, activities and audiences, this study focused on continuing education programs designed to enhance the knowledge, attitudes, or skills of practicing engineers.

Historically, businesses and universities have engaged in various kinds of collaborative relationships; research, consulting, student recruitment, grants, and contracts. However, the heightened interest in forging stronger alliances between the two sectors is unprecedented.

Why is there such an interest? Given their different goals and purposes, what factors would compel the two groups to seek stronger ties? Fundamental societal changes have had a profound impact upon businesses and universities. These changes have contributed to the growing interdependence of the two groups. For industry, the unrelenting pace of technological change has underscored the role that research and development can play in maintaining or enhancing competitive position. While many

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industries maintain their own research labs, an increasing number of industries have leveraged their research dollars by establishing collaborative research centers with universities. Collaborative continuing education workshops, seminars, and conferences provide opportunities for representatives of university and industry to discuss research projects, findings, and applications. Also, the publication of conference proceedings provide an additional avenue to faculty for the dissemination of research findings.

Further, increased international competition has placed a premium upon a skilled and knowledgeable workforce. Technological change impacts the vitality of the workforce, which raises important issues of re-training and re-education for industry employees. While industry has assumed a considerable responsibility for such training and education, collaboration with universities in the development of continuing professional education programs provides another mechanism to address this pressing need.

Universities also face circumstances that encourage collaboration with industry. Universities are confronted with declining resources, including reduced state funding for public institutions and reduced federal funding for research. Collaborative relationships with industry provide a forum for the development of basic and applied research, as well as a vehicle for obtaining valuable resources. Collaboration between universities and industry in the development of continuing professional education also reflects changes in the pool of students that attend universities. Demographic changes have resulted in fewer numbers of 18-22 year old students, and an increasing number of adults who are seeking continuing professional education.

Collaborative efforts by universities and businesses in the provision of continuing professional education pose several interesting questions. Do these relationships reduce the marginality of a continuing education unit within a university, by strengthening its ties with academic units of the university and by enhancing the fiscal position of the continuing education unit? In what ways do the relationships affect the academic unit(s) and contribute to its(their) goals? Does the university, as a whole, benefit as a consequence of the relationship; through resulting research, grants or contracts, corporate philanthropy, increased admissions or placement? What corporate goals are advanced? These questions suggest that collaborative relationships are of strategic significance because of their potential impact upon the vitality of the corporation, the academic unit(s) and continuing education unit of the university, and the university as a whole.

Cross (1981) suggested that the establishment of mutually supportive partnerships with businesses and universities is an essential task. But what will be the nature of these relationships? The literature contains various anecdotal examples of corporate/campus collaboration in continuing professional education. But too little is known about the nature of these relationships and their administrative structures. Nowlen (National Continuing Education Association, 1987) stated that the nature of collaborative relationships in continuing professional education must be defined. This study examined these issues.

Research Questions

This study profiled the relationships between a set of universities and businesses in the provision of continuing engineering education in order to better understand three central issues in collaboration. These issues included:

1. What organizational goals and objectives of both groups are being served by the collaboration? What are their expectations? What are they trying to achieve?

2. How has the collaboration been implemented? Who has provided impetus for the partnerships? What are the formal or informal administrative structures that support or impede the activities?

3. What incentives are provided to the individual members of the two groups? How are faculty rewarded? What incentives are present for corporate employees to participate in these continuing professional education programs?

Review of Related Literature

Various studies and literature have provided an examination of issues pertaining to collaboration in continuing professional education among businesses and universities. These are briefly summarized below.

Continuing professional education

Literature on continuing professional education defines the context in which the collaboration occurs. This body of literature also addresses underlying assumptions that are made about the professions and the complexities involved in developing educational programs that are both appropriate and relevant to the professions.

By definition, continuing professional education is concerned with the development of programs for the *professions*. But, as Houle (1980) has suggested, there really are no professions, just occupations in various stages of professionalization. As such, all occupations must continuously strive for development and improvement which can be achieved, in part, through continuing professional education.

Development of programs is influenced by the various beneficiaries of continuing professional education including the individual professional, his employer, society or some combination thereof. Darkenwald and Merriam (1982) exposed the various and potentially conflicting benefactors of continuing professional education in listing these purposes: to cultivate the intellect, to facilitate individual self-fulfillment, to promote personal and societal improvement, to catalyze social transformation, and to advance organizational effectiveness.

The stakes in continuing professional education have been further raised by recent social, technological, demographic, and economic change which have impacted the workplace and, correspondingly, the professional workforce. Changes in the complexity and nature of our society increase the importance of professionals' capacity for adaptation and learning (Stern, 1983).

Several authors (Boyer, 1985; Cross, 1981, 1985; Darkenwald & Merriarn, 1982; Keller, 1983; Lynton & Elman, 1987) have detailed changes that have direct consequences for continuing professional education. These include:

1. half-life of knowledge acquired in professional schools has been reduced

2. increased globalization of the economy and increased international competition have accelerated job demands

3. nature of work is becoming increasingly interdisciplinary, the professions increasingly interdependent

4. aging of the United States population has resulted in an older workforce in need of retraining and re-education

5. mobility of the workforce has increased between jobs and occupations

Corporate Education

The literature on corporate education reveals business perspectives that direct the development of training and education programs for corporate employees. Collaborative relationships must be considered in light of these perspectives and trends.

The growth of corporate education in the United States has paralleled the development of business and industry (Darkenwald & Merriam, 1982; Eurich, 1985 Knowles, 1962; Lynton, 1984). Industrialization, World War I and II impacted the nature and scope of training and education programs in industry

Today there are approximately 400 business sites that include a building or a campus dedicated as an educational center. U.S. companies are training and educating about eight million people, close to the total enrollment in America's four-year colleges and universities (Eurich, 1985).

Corporations have invested approximately $60 billion (Eurich, 1985; Lynton & Elman, 1987) for education and training, a figure that approaches the total annual expenditure of colleges and universities in the United States.

Corporations engage in education and training for many reasons, including compensatory education, company-oriented education, to up-date and enhance employee competence, to compensate for employee attrition, to fill a void unmet by some higher education institutions, as an employee benefit and as a recruitment tool (Eurich, 1985; Hawthorne, Libby & Nash, 1983; Lusterman, 1977). Lusterman's study (1977) provided examples of the various learning activities provided by business and industry. The programs included courses in management development and supervision, functional and technical courses, administrative programs, and financial courses. In addition, several of the larger corporations have developed elaborate training centers, including Xerox, AT&T, IBM, and McDonald's.

The development of corporate colleges, institutions which provide accredited degrees, represents a further step by corporations in the provision of training and education. Of the eighteen corporate colleges identified by Eurich (1985), five offer engineering degrees including DeVry Institutes of Technology, G.M.I. Engineering and Management Institute, National Technological University, Northrup University, and Wang Institute of Graduate Studies. While corporate colleges share some characteristics of traditional higher education institutions, they are also markedly different. While they may be largely non-profit accredited institutions offering a range of academic degrees, they utilize a greater number of part-time faculty, offer no tenure and are organized by multidisciplinary units rather than academic departments.

While the growth of corporate colleges represents an interesting development in education and training, Henry Spille, American Council of Education's Director of the Center for Adult Learning and Education Credentials, suggested that business and education partnerships hold more promise than widespread creation of corporate colleges (Wilcox, 1987).

Collaboration Between Universities and Corporations

The literature is rich with descriptions of various kinds of collaborative arrangements among businesses and universities. These relationships, including those in continuing professional education, reveal both some of the possibilities and the difficulties of engaging in such collaboration.

Collaborative relationships between universities and corporations are not a new phenomenon (Brown, 1985; Gold, 1981; Johnson & Tornatzky, 1981; Lynton, 1984; Lynton & Elman, 1987). But these relationships are changing and becoming increasingly complex, in part because various forms of collaboration have proliferated. Relationships have also been affected by the technological, social, economic. and political changes discussed earlier.

One dramatic example of the impact of these changes can be seen in the area of funding for university research. As federal and state funding of research has declined, corporate funding of research has significantly increased. The National Science Foundation estimates that corporate expenditures on university research will total $670 million this year, up from $235 million in 1980.

In addition to the funding of research, various university/industry relationships have been suggested (Brown, 1985; American Council on Education, 1980) including: faculty consulting, exchange of personnel, continuing education of professionals, service on institutional advisory boards, access to institutional facilities, equipment and materials, and corporate financial support.

Collaboration by corporations and universities in the development of continuing professional education can be viewed as a strategic tool to assist organizations in accomplishing their fundamental goals and objectives (Beder, 1987). For research universities, continuing professional education provides a forum for the dissemination of research findings. Collaboration between industry and universities in the development of continuing professional education programs provides a mechanism for business to address the education and training needs of employees. Such relationships provide a vehicle for obtaining valuable resources, for both the participating university and corporation.

The advantages and disadvantages of collaboration in continuing professional education have been considered by several authors (Fischer, 1987; Foster & Rippey, 1985; Gold, 1981; Hohmann, 1985). Generally, the advantages cluster around pedagogical issues; the ability to access faculty expertise, the opportunity to utilize the resources of a university, the chance to obtain cross-industry perspectives. The disadvantages tend to focus upon both pedagogical and administrative issues; program content which is too theoretical, programs which do not reflect the special learning circumstances of adults, the lack of flexibility in location and scheduling, and programs considered to be excessive in length.

Collaborative linkages in continuing professional education often represent only one dimension of a complex network of activities between a university and a corporation. For example, at Colorado State University, a software program has been developed for Hewlett-Packard engineers. In addition, Colorado State University has received donations of equipment from Hewlett-Packard. University faculty have access to Hewlett-Packard experts and collaborative research opportunities. The University of Illinois at Chicago offers a master's degree program for Motorola employees. Faculty also consult at Motorola and the university has received donations of equipment from Motorola (National Continuing Education Association, 1987).

While various examples of collaboration among universities and corporations have been documented in the literature, these reports tend to provide basic, descriptive information about the content of the programs and their administrative arrangements. Various questions persist about the nature of these relationships including, why and how they are established, and the manner in which they are implemented and maintained. Do relationships in continuing education result in other collaborative linkages? These questions were addressed in this research study.

Decision-Making: A Conceptual Framework

The foregoing review of literature underscores the complexities of developing collaborative relationships among universities and businesses. How can collaborative relationships be analyzed, given the range of goals and purposes, the different organizational structures, and the various interest groups?

The literature on decision-making provides a conceptual framework for analyzing collaboration among businesses and universities. This study drew upon the work of Graham Allison (1971), who in Essence of Decision described three decision-making models useful in understanding decisions in organizations. The models include the rational, bureaucratic. and political models. Allison suggested that more powerful analyses of organizational behavior are derived when all three models are utilized.

The *rational model* depicts action as rational choice. Also referred to as the "classical" model, Allison states that most analysts use this conceptual model to explain or predict the behavior of organizations. The organization (i.e. the university or corporation) is conceived as a rational decision-maker, a single agent, whose choices maximize strategic goals and objectives. Thus the decision-making formula for the organization is to determine goals and objectives, assess options and consequences and select the best alternative. This model assumes that actions are performed by unified, purposive agents, and that what human beings do is at least "intendedly rational."

The *bureaucratic model* depicts action, less as deliberate action, and more as outputs of large organizations functioning according to standard patterns of behavior. This model underscores the complexities of organizations that "consist of a conglomerate of semi-feudal, loosely allied groups, each with a substantial life of its own" (Allison, 1971, p. 67). Drawing upon the work of Simon (1957), March and Simon (1958), Cyert and March (1963), and others, Allison probed the effect of these complex organizational structures upon decision-making. In managing their various responsibilities, large organizations decentralize; problems are cut up and parcelled out to various sub units. Further, power must accompany delegated responsibility to avoid paralysis within the organization. Standard operating procedures and routines provide a necessary mechanism for managing the general functions of complex organizations. These routines affect the range of choices in a given situation and, in fact, can constrain decisions of leaders. Analysts utilizing this model uncover the standard operating procedures of the organization as they contribute to the organizational output in question, and study the major factors that support or impede these routines.

The *political model* depicts action as a resultant of political bargaining among a number of independent players. As such, the action may not reflect any one preferred solution, but rather a compromised result by officials with diverse interests and influence. This model focuses on the key decision makers; their positions, power, priorities, stakes, and stands. This model recognizes the role of individuals who are in environments that are frequently ambiguous and uncertain. Their influence is inevitably constrained by the "pace of the game" --the multitude of issues and the time constraints that can easily result in misperceptions, misexpectations and miscommunication.. Analysts utilizing this model strive to uncover the political process; the players, their positions, preferences, the pulling and hauling, and the bargaining that resulted in the action in question.

In summary, these conceptual models reflect clusters of assumptions that influence what the analyst finds puzzling, what questions are asked, how data are both collected and analyzed. The models complement each other. The rational model stages the broader context, the larger organizational issues, and shared images. The bureaucratic model illuminates the organizational routines that produce informations, alternatives, and action. The political model focuses on the individual leaders of the organization and the politics that determine choices. The best analysts weave the strands of each of the three conceptual models in their analysis, according to Allison.

The research questions of this study reflected a consideration of each of the models.

Methodology

The researcher utilized qualitative interviews to understand programs in different settings and to record the complexities of the respondents' perceptions and experiences. The study drew upon the pioneering work of Glaser and Strauss (1967) who developed an approach to research they termed "grounded theory." The grounded theory approach to qualitative research is inductive, pragmatic and highly concrete, according to Patton (1980).

Sample

As discussed earlier, universities and businesses share a long tradition in collaborative activities of various types. By definition, research universities are differentiated from other higher education institutions by their research activity. This dimension can be of special interest to corporations whose competitive position depend upon advances in technology and other products of the research enterprise. This study focused upon collaborative continuing engineering education among a group of research universities and corporations in order to explore the nature of these activities within such a complex environment. The sample of research universities was derived by selecting institutions with established relationships with industry for the funding of research.

Selected for this study were four universities among the top ten recipients of research funds from corporations in 1986, as reported by the National Science Foundation (Sims, 1987). The universities' specific rankings within the top ten recipients are not reported to protect confidentiality. This sample included two public and two private institutions located in three urban and one rural setting. In addition, each of these universities had strong schools/colleges of engineering. All four universities were ranked among the top 20 engineering schools/colleges in the United States, according to a study published by the U.S. News and World Report ("Nuts and Bolts," 1987). Also, each of the universities was classified as Research Universities I, according to the 1987 edition of *A Classification of Institutions of Higher Education,* by The Carnegie Foundation for the Advancement of Teaching.

In addition to these four universities, a fifth university was selected to pilot the interview questions. This university was a public research university with two colleges of engineering located on two campuses, one in an urban setting and the other located in a semi-rural setting. This university shared many of the same attributes of the other four universities: it was a major recipient of research funds from corporations, one of its colleges of engineering was listed among the 20 schools/colleges of engineering as described above, and it was also classified as a Research University I.

Each of the five universities selected for this study agreed to participate in this research. Additional information about these universities is contained in Table 1. The five universities were given fictitious names to protect confidentiality. Their status as public or private institutions is reported. The size of the institutions, which was determined by institutional enrollment, is indicated as small, medium or large. Engineering enrollment, including both undergraduate and graduate students, is also reported in Table 1.

Table 1

Information About Participating Universities

University	Size*	Type	Engineering Enrollment
Adams University	small	private	5,000
Blackburn University	small	private	1,900
Grays University	large	public	9,000
Markham University	large	public	10,900
Wheeler University	medium	public	7,500

*Small: institutional enrollment less than 10,000. Medium: institutional enrollment 10,00025,000. Large: institutional enrollment over 25,000.
**1987 engineering enrollment rounded to the nearest one hundred; undergraduate and graduate combined.

In sum, this sample of universities was typified as prominent research universities, with nationally recognized schools/colleges of engineering and established relationships with corporations for the funding of research. Using this sample of research universities, the corresponding relationships with corporations in the development of continuing engineering education programs were investigated.

Data Collection

The researcher utilized various sources of data, including personal interviews, telephone interviews, documents, and other written materials. However, the bulk of the data was collected from 50 interviews, including 38 personal and 12 telephone interviews. Thirty-six of the 38 personal interviews were tape recorded to aid in data analysis. In two cases permission could not be obtained to tape record the interview. The telephone interviews were not recorded, but detailed notes were kept. A variety of sources was utilized to develop the interview questions including the work of Dexter (1970), Patton (1980), Spradley (1979), and Sudman and Bradburn (1982).

1. Exploratory interviews were conducted with the dissertation committee members and other individuals recognized for their understanding of collaborative ventures among universities and corporations. These individuals included the president of a prominent research university, a noted author of two books on collaboration among universities and business, another author and educator in the field of continuing higher education, the president of a national association for continuing educators working in university settings, and the director of a university research institute which fostered collaborative partnerships with industry. The research proposal was written upon completion of these exploratory interviews and a review of the literature. Interview questions were subsequently developed. This stage of data collection occurred during January through April, 1988.

2. Pilot interviews were conducted at one of the universities. Seven personal interviews were conducted during May and June, 1988. This activity was useful in acquainting the researcher with the interview process. The researcher noted that in striving to achieve a conversational tone with the participants, the order and pace of the questions would vary from interview to interview.

3. Personal interviews at four universities were conducted. A letter of introduction, from the dean of engineering at the University of Illinois at Urbana-Champaign, was sent to the dean of engineering at each of the universities. The letter explained the purpose of the study and requested the participation of the dean. The researcher

subsequently called the dean of engineering at each of the universities to secure appointments with individuals within the school/college of engineering involved in the design and/or delivery of collaborative continuing engineering education programs.

The researcher also scheduled appointments with continuing education administrators, where appropriate. In addition, the researcher met with senior level university administrators in order to obtain a broader university perspective of the collaborative continuing education activities. A total of 15 interviews was conducted during June and July, 1988. Various materials, such as brochures, budgets, written agreements, evaluations, and other written documents relevant to the collaborative activity were obtained when possible.

Initial data analysis was conducted using the information obtained from the pilot university and the other four universities. Eight programs from three of the universities (Adams, Markham, and Wheeler) were selected for further study. This determination was based on cases which seemed particularly interesting, rich in description, and broad in appeal. Specifically, this group of eight programs represented activities in various stages of age and development; four programs were established within the last two years, three other programs were initiated eight to ten years ago, and one program was established 40 years ago. In all but one case these programs were master's degree programs. They utilized various modes of delivery; four were held on the university campus, two were held at the corporate site, and two featured video-taped instruction at various corporate sites. In addition, the programs of these three universities utilized different administrative structures; Adams University was decentralized, Wheeler was highly centralized, and Markham featured a mixed administrative structure, with some functions centralized and other functions decentralized. Other unique characteristics influenced the selection of the eight programs; one program had resulted in a significant research initiative, another involved local industry, and still another employed multiple corporate sites.

4. A second round of personal interviews was conducted at Adams, Markham, and Wheeler Universities in order to collect information from 14 faculty and administrators directly involved in the eight programs described above. Then nine corporations involved in seven of the eight collaborative programs were selected for study. Access to corporations involved in one of the eight programs could not be obtained, because the university program director wanted to

protect their confidentiality,v. A profile of these nine corporations is contained in Table 2. The names of the corporations are not reported in order to protect confidentiality. Instead a brief description indicates the business of the company. This group of corporations was dominated by firms in the electronics and computer science industries. Table 2 also reports the corporations' 1987 net sales, research and development expenditures, and the percentage of research expenditures to sales.

Table 2

Information About Participating Corporations

Type of Corporation	1987 Net Sales*	R & D Expenditures*	R & D % to sales
aerospace corporation	$800	na	na
automatic test equipment	$378	$62	16.0
computer systems	$9,389	$1,610	17.0
electric utility	$3,615	-	-
electronic equipment manufacturer	$6,707	$524	7.8
electronic systems	$7,659	$266	3.5
information systems	$33,598	$2,453	7.3
petroleum products	$34,372	$277	.8
power systems	$3,042	-	-

Note. Data obtained from 1987 annual reports of corporations. A dash indicates data inapplicable. The notation 'na' indicates that the data was not available.
*In millions of dollars.

Personal interviews were conducted with representatives of two corporations involved in these collaborative activities. A total of 16 individuals was interviewed during this stage of the research conducted during September and October, 1988. Corporate representatives were selected from persons who were knowledgeable about the development and implementation of the continuing education programs. This group included those acquainted with the goals of the company for the program, the individuals responsible for providing impetus to the program, and those involved with the administrative structures and employee incentives established to support the program.

Typically, these representatives were drawn from the corporation's office of human resource development or training, the engineering technical staff, and the corporate management office.

5. Telephone interviews were conducted with representatives of the nine corporations involved with the seven programs selected for further analysis from the three universities. Twelve telephone interviews were conducted during October and November, 1988. These corporate respondents and the university participants are described in the following section.

Study Participants. As indicated earlier, a total of 50 interviews was conducted, including 38 personal and 12 telephone interviews. Of this total, 36 university interviews and 14 corporate interviews were conducted. About half of the total respondents (26) were engineers. Of the total, 41 were men and nine were women. Of the 36 university participants, 18 were engineers. Of the total, 18 interviews were conducted with members of the school/college of engineering, 11 were with continuing education administrators, and seven were with members of the university administration. The positions of these university participants included:

-3 chief academic officers
-1 vice president
-1 associate provost
-3 engineering deans
-3 associate/assistant deans of engineering
-13 directors
-1 department head

-3 associate/assistant directors
-2 program managers
-6 engineering professors

Of the 14 corporate participants, eight were engineers. Of the total five interviews were conducted with members of the technical staff, five worked in training and development, and four worked in corporate management Their positions were:

-1 senior executive vice president
-1 department head
-2 corporate managers
-6 training and development directors/managers
-4 engineers

Data Analysis

Two types of data were analyzed in this study; the data collected through interviews and the documents obtained from each of the participating universities and corporations. Allison's (1971) conceptual framework of decision-making was considered during the data analysis. In addition, the literature on grounded theory (Glaser & Strauss, 1967; Schatzman & Strauss, 1973) and qualitative methods (Denzin, 1978; Miles & Huberman, 1984; Patton, 1980) was utilized to guide the process of analysis. Miles and Huberman (1984) discussed three strands of activity that are interwoven before, during, and after data collection. These processes of data reduction, data display, and conclusion drawing/verification were utilized to develop categories describing the features of the collaborative arrangements.

To aid data analysis, the taped interviews were transcribed, resulting in about 1200 typed pages. The content of the transcriptions was analyzed and a brief summary of each interview was prepared, resulting in about 55 hand-written pages. In addition, quotes pertinent to the research questions were highlighted. The notes taken during the telephone interviews and two personal interviews that were not recorded were similarly analyzed. This second process yielded about 77 hand-written pages of quotes. The summaries and quotes were then reviewed for themes. The themes were then clustered under each of the three research questions. A section for each of the three research questions was written, drawing upon these themes, summaries, and quotes.

Limitations

A qualitative study of this type was subject to certain inherent limitations. It had limited generalizability because of the relatively small sample of universities and corporations selected for the study. However, as Weick (1979) has noted, it is impossible for a study of social behavior to be simultaneously general, accurate and simple. He suggested that, at most, two of the virtues can be secured. This study attempted to be accurate and simple.

The criteria utilized in selecting the research universities and corporations for the study represented an additional limitation. Other limitations included the researcher's biases, preconceptions, perceptions, and skill to analyze data appropriately. Limitations of time and resources further impacted the results of this research. Despite these limitations, the study contributed to an understanding of collaboration between universities and corporations in the provision of continuing professional education programs for engineers.

Findings

The research focused upon three research questions chosen to explore the goals and expectations of the universities and corporations, the ways in which collaboration was implemented, and the incentives provided to faculty and corporate employees to participate in the collaborative activities. Following is a discussion of the findings.

Goals and expectations

Representatives from each of the universities and corporations in this study discussed the goals and objectives of their collaborative efforts. Goals were multi-dimensional and addressed not only a concern for sustaining competence among groups of engineers, but also how these collaborative relationships could contribute to the long-term health of the university arid corporation.

In defining goals that would serve both these individual and organizational needs, each university carefully targeted and the corporation carefully selected their continuing engineering initiatives so that they were compatible with other institutional goals. These broader institutional goals impacted the nature and scope of the collaborative efforts of the corporations and universities as they sought to determine the boundaries and limits of their involvement in continuing engineering education.

An important goal of the collaborative relationships in this study was the development of programs designed to assist engineers cope with technological changes in order to remain competent. But the continuing education of individual engineers was not a sufficient, or perhaps even primary, goal in building these complex relationships. Instead, a principal goal was that these activities contribute to the vitality and long term survival of the universities involved. Collaboration for both sectors was driven by larger institutional agendas. Organizational health was promoted as the organizations sought to:

-Build relationships between universities and corporations
-Serve various constituent groups
-Generate funds for universities
-Develop relationships among corporations

The Implementation and Structure of Collaboration

The implementation and structure of collaboration involved groups of individuals who shaped and defined the program through their decisions. Often certain individuals within the university or corporation championed the collaborative effort. Various factors influenced the content, format and delivery of the continuing education programs including the program audience, budget, credit vs. non-credit programs, faculty, location, scheduling, and use of technologies. The use of technology (such as video-taped instruction, satellite transmission, teleconference methods, computer-aided instruction) had vast implications for the design and delivery of the continuing education program in these collaborative efforts. The increasing sophistication in the type and quality of these technologies were driving the universities and corporations in this study to examine or re-examine the application of these electronic means to their continuing education activities.

Various administrative structures were utilized in the collaboration ranging from highly decentralized to highly centralized structures. Efforts to integrate and coordinate activities influenced the collaboration, as did certain logistical issues including the program fee, written agreements, and program facilities.

The decision to collaborate usually involved a number of individuals from the participating universities and corporations. Typically within a university, representatives from both the faculty and the administration were involved in the decision to collaborate. This group might include faculty from one or more departments, the department head(s), the dean and/or associate dean(s) of the school/college of engineering, representatives from the continuing education unit(s), and others from the university's central administration.

Within a corporation, members of both the technical and administrative staff usually participated in decision-making. This group might involve a select group of employees, representatives from technical unit(s), training and development staff foundation staff, and various corporate officers.

Incentives for Collaboration

A variety of incentives were utilized to attract university faculty and corporate employees to participate in these collaborative programs. Universities utilized faculty selectively, provided various extrinsic and intrinsic rewards, and in some cases, considered modifications to promotion and tenure systems. For corporate employees, different extrinsic and intrinsic factors were utilized to attract them to these programs. These rewards were coupled with enhanced job satisfaction, professional advancement, and job mobility. In some cases, corporate directives, such as one which specified that certain projects required employees with masters degrees, provided an additional incentive for participation.

Katz and Kahn (1978) suggested that three motive patterns were particularly important in organizations: (a) compliance with rules; (b) responsiveness to economic returns and external rewards; and (c) value consensus and intrinsic rewards. They also claimed that organizations capable of achieving a balanced set of the three motives could achieve higher levels of functioning. That is, the sum of the three motives is greater than the parts. Katz and Kahn (1978, p. 292) stated, "When organizations can fuse all three forms of commitment, so that people get material benefits from following rules the justification for which reflects their own basic values, the resulting lift in motivation is marked."

Conclusions and Implications

The findings of the study suggest the following conclusions:

1. These collaborative activities were largely driven by fundamental societal changes and factors external to the universities and corporations. In most cases the university and corporate members of this study were not motivated by an enlightened appreciation of the importance of adult education as espoused by Eduard Lindeman or the role of education in the democratization of society as discussed by John Dewey. These individuals were driven largely by external factors which impacted their universities or corporations in ways largely unprecedented. The social, demographic, and economic changes discussed earlier had real consequences for the institutions of this study. Collaborative programs provided a mechanism to address some of these social issues; the need for a skilled and knowledgeable work force, the importance of research, development and technology transfer in economic development; and the leveraging of scarce resources in an increasingly competitive environment.

Yet the organizations, by nature, were conservative and resistant to change. These collaborative programs challenged the nature of the organizations as fixed, stable states. Their identities as "research universities" were influenced by these programs as they accommodated the collaborative initiatives within their respective missions and purposes. Such evolution isn't particularly startling when one considers that the concepts of organized scientific research and the research university are less than one hundred years old (Bok, 1982; Ikenberry & Friedman, 1972; Keller, 1983; Kerr, 1972). And Schon (1967, p xiv) similarly noted that corporate research and development is a relatively new phenomenon established in this century. The collaborative programs of this study, buoyed by the efforts of product champions, pushed the boundaries of conventional definitions of these institutions.

Organizational and environmental determinants influencing collaborative ventures were addressed in a recent book by Ronald Cervero (1988). Cervero suggested a cost-benefit analysis for the evaluation of collaborative ventures (pp. 104-111). Cervero identified three organizational and environmental factors that decision makers must consider in evaluating collaborative opportunities:

1. Permeability of organization's boundaries - Organizational boundaries will differ in the degree to which they are open and permeable. Organizations with more permeable boundaries are more likely candidates for collaboration.

2. Complementary goals - Each organization must recognize benefit from the relationship, although their respective goals may differ. In fact, goal similarity may be undesirable since it can result in a competitive situation among organizations.

3. Available resources - The ability of an organization to utilize and mobilize slack resources can impact the organization's readiness to collaborate.

The activities presented in this study were limited in number and were often treated as experiments. There was evidence, though, that the level of these collaborative activities had increased in the last two or three years. In addition, the respondents' participation in various ongoing activities demonstrated a continual effort to define their precise roles in these collaborative activities.

The influence of the external factors upon the collaborative activities of the institutions in this study suggested a qualification to five objectives for collaboration suggested by Beder (1987). These objectives include:

> 1. Domain extension - ability to extend the traditional boundaries of the continuing education unit through collaborative relationships with industry.
>
> 2. Co-optation - ability to defuse competition by assimilating programs (that had been lodged in industry) within the continuing education unit.
>
> 3. Cost-reduction - ability to reduce operating costs (such as marketing expenses).
>
> 4. Risk reduction - ability to reduce program risk, such as by securing clients in advance, through collaboration.
>
> 5. Powerful alliances - ability to reduce the marginality of the continuing eduction unit within the university, by forming alliances with the academic units and industry involved in the collaboration.

The first four objectives directly address organizational concerns of a continuing education unit in remaining healthy and viable. However, from a broader institutional perspective, they may not be sufficiently compelling reasons for collaboration. The objective of developing powerful alliances, while a legitimate goal for a continuing education unit, can also represent an over-arching institutional objective. In this study, the ability to establish such powerful alliances among various institutional units was an important objective.

2. Collaboration influences the definition of continuing professional education: it suggests both a broadened and a more narrow definition among the universities and corporations in this study. Houle (1983, p. 254) suggested that, "At a minimum, continuing professional education appears to be a complex of instructional systems... offered by many providers to keep professionals up to date in their practice." The findings of this research suggest that continuing education of individual engineers was not a sufficient or perhaps even primary goal in building these collaborative relationships.

The findings of this research suggested that these collaborative activities attempted to serve various and potentially conflicting benefactors of continuing professional education, which included those identified by Darkenwald and Merriam (1982): intellectual cultivation, self-fulfillment, personal and societal improvement, social transformation, and organizational effectiveness.

As the universities and corporations specified the goals and expectations of their collaborative activities, they also specified more closely their definition of continuing professional education. By detailing what they hoped to achieve from the continuing engineering education programs, they revealed their 'working definition' of continuing professional education at their institutions. The findings suggest both a broadened and a more narrow definition of continuing professional education among the universities and corporations in this study.

The definition was broadened by the interest of both sectors in coupling continuing engineering education programs with other institutional activities. For universities, continuing engineering education provided a vehicle to promote research, student recruitment and placement, and to encourage corporate philanthropy. For corporations, continuing engineering education programs offered a mechanism to provide educational programs to their employees, gain access to faculty research and consulting, aid technology transfer opportunities, and recruit university students.

In other ways the definition of continuing professional education was narrowed by the universities and corporations of this study. Universities are not the sole providers of continuing engineering education, nor do they aspire to be so. For the research universities in this study, continuing engineering education programs were generally provided for select groups of engineers featuring select topics. This group might include engineering alumni from certain disciplines, such as computer science and electrical engineering. In other cases programs were targeted to research engineers working in high technology companies who were interested in cutting-edge research and technological advances.

For corporations, participation in these collaborative activities was targeted at selected universities. In some cases they sought advanced degree programs for specific groups of engineers within their company. In other instances they sought continuing engineering education programs that featured research updates and advances in technology.

3. Collaboration involves a complex network of decisions, interpersonal relationships, and activities. Collaboration for the universities and corporations of this study was not a random event; it involved various groups of decision-makers, interpersonal relationships, program development issues, and the coordination of a number of activities. Each of these factors affected the design, implementation, and on-going management of the collaborative activity. These findings suggest that collaboration is difficult to design, implement, and manage.

Certain individuals helped to provide impetus to the programs and championed the collaboration in various ways. These ways included securing support from other influential people, obtaining valuable resources for the program, and/or developing the content of the engineering program. Universities and corporations addressed various program development issues including program audience, budget, credit vs. non-credit programs, faculty, location, schedule, and use of technologies. These issues reflected the kinds of problems traditionally discussed in the continuing education literature, including the more recent issue of technology. Advances in technologies have created a wide-range of tools useful in the design and delivery of continuing education. Each of the members of this study was evaluating the extent to which technologies could be used to enhance or expand the reach of their collaborative efforts.

Collaborative programs were administratively 'housed' in both centralized and decentralized structures. Perhaps more important were the efforts made to integrate and coordinate activities across structures, since the success of collaboration depended upon the involvement of a number of constituent groups within both the university and the corporation.

4. Incentives coupled with the personal and professional interests of university faculty and corporate employees advances collaborative activities. The collaborative programs in this study offered incentives to faculty and employees that extended beyond the payment of stipends or other monetary rewards. These incentives, linked to the personal and professional interests of faculty and employees, advanced collaborative efforts. As previously discussed, the goals of the collaborative efforts were multidimensional involving a range of activities that supported the vitality of the universities and the corporations. These goals and activities affected the incentives that were provided to university faculty and corporate employees.

For universities, collaborative programs in continuing engineering education provided an avenue to extend their regular effort in on-campus teaching and research. Some faculty were attracted to the released time that provided blocks of uninterrupted time they could devote to research. Others applied the technologies of the continuing engineering education program to enrich their on-campus teaching environment. Still others sought to pair the collaborative continuing education program directly with their research, by involving the corporation(s) in the funding and/or the conducting of the research project.

Even when these efforts to couple were successful, however, the role of faculty in these collaborative programs posed t oubling questions. Given limited faculty resources, how much emphasis should be placed upon these continuing engineering education programs? How should faculty involvement in these collaborative programs be evaluated for promotion and tenure, if they contributed not oniy to the service mission, but to the teaching and research mission of the university? Should tenure and promotion systems be modified to reflect an emphasis on these collaborative efforts? Each of the universities in this study was struggling to address these questions.

For corporate employees, various extrinsic and intrinsic factors were utilized to attract them to the collaborative programs. These rewards were coupled to enhanced job satisfaction, professional advancement, and job mobility. The opportunity to attend programs from a prominent research university with a nationally ranked college of engineering provided advantages extending beyond the continuing engineering education program. One advantage was the chance to develop relationships with university faculty that could result in consulting relationships and/or collaborative research projects. In addition, as the corporate employees became better acquainted with the university, the corporation could enhance its student recruitment and placement programs.

Typically, corporations developed a portfolio of credit and non-credit programs offered both in-house and in conjunction with other providers. For corporations, collaborative programs provided an additional means to both serve the educational needs of its employees while enhancing its relationships with the involved university.

Implications for Practice

The findings of this research suggest implications for continuing education practitioners. Since this study focused upon continuing engineering education among research universities and corporations, implications are particularly directed to practitioners working in those settings. Practitioners working in other settings, such as professional associations and independent organizations, may also be interested in these implications for practice.

Collaboration in continuing engineering education requires a host of decisions and processes. Such relationships don't just happen, they must be planned and actively managed. The findings suggest that the management, or perhaps the nurturing of these collaborative activities requires thoughtful planning, cooperative decision-making, and on-going communication among the involved parties. Practitioners must consider the obstacles and impediments in evaluating the merits of collaboration.

Obstacles and Impediments

While the benefits of collaboration can be appealing, the real problems and difficult obstacles involved in implementing these activities must be recognized. Following is a listing of some of the dangers confronting those interested in pursuing collaboration as an institutional strategy:

1. These relationships are not achieved quickly. They are time consuming and involve the development of good interpersonal relationships.

2. The collective process used for decision-making in collaboration is a double-edged sword: it can build commitment for the venture, but its slow, deliberate manner can impede progress.

3. Support from key decision-makers may not be obtained or it may be sufficiently weak to jeopardize the long-term viability of the collaboration. The interests of constituent units must be addressed.

4. The organization may not possess program "champions" who can provide vision and energy to the collaboration. It may not contain the necessary support staff capable of carrying out the details of the relationship.

5. University faculty may not be attracted to the rewards offered by the collaborative venture. Or they may be so attracted to the collaborative activities that they become distracted from their core tasks. Still other faculty may be interested in participating in the collaboration, but are not a good match for the needs of the corporation.

6. The corporate employees may not be sufficiently motivated to participate in the collaboration. They may not be given adequate support from management or their direct supervisors. Or the logistical arrangements (such as program location, schedule, or matriculation policies) may present serious obstacles to their participation.

7. Slow or cumbersome organizational procedures within the university or corporation can jeopardize relationships.

8. Collaboration between a university and corporation may breed unhealthy dependence. What happens to the relationship if the corporation fails, is re-located or is acquired by another corporation?

9. The establishment of collaborative linkages of one university with one corporation may constitute an unfair competitive advantage. For example, limited resources may restrict a university from collaboration with the corporation's competitor. Or conversely, the corporation may select to collaborate with one university over another.

Guidelines for Implementation

A number of variables can jeopardize the success of collaboration as discussed above. For some institutions, collaboration may not represent a viable organizational choice. For other organizations, however, the potential benefits of collaboration may compel them to consider strategies for implementation. The programs of this research represented a range of activities from different organizational settings. Despite these differences, however, certain common themes suggested the following guidelines for implementation of collaborative programs:

1. Carefully match the university and cooperation to reflect compatible goals and objectives for the collaboration.

2. Identify and involve key decision-makers within the university and corporation. Locate and use product champions.

3. Actively define the role of school/college of engineering in these collaborative efforts. Consider engineering strengths, new initiatives or priorities, and research agendas.

4. Match content of collaborative programs to reflect institutional strengths and educational needs of specific groups of engineers, including engineering alumni. Provide opportunities for employees of different corporations to meet with one another, where appropriate.

5. Foster coordination and integration of activities across administrative units/structures.

6. Use faculty selectively and mobilize various intrinsic and extrinsic rewards to reflect individual interests.

7. Determine existing ties with corporations, build upon such relationships in establishing collaborative continuing engineering education programs.

8. Recognize the length of time needed to develop collaborative relationships. Consider use of a 'mixed portfolio' of programs that will meet needs for short, medium, and long-term situations.

9. Identify and serve constituent groups of these collaborative efforts as appropriate, both within the university and the corporation.

10. Know your engineering faculty, their teaching and their research; note any existing relationships with corporations.

11. Devise employee incentives to reflect appropriate intrinsic and extrinsic rewards, particularly those associated with job satisfaction and professional advancement.

12. Utilize technologies to extend and/or enhance collaborative activities, where appropriate.

13. Assess collaborative programs at other universities and corporations in light of own institutional context. Test, modify programs.

14. Consider the various rational, bureaucratic, and political factors that impact the collaborative effort. Seek to maximize advantageous ones.

Implications for Research

The design of this study limited analysis of collaborative relationships in continuing engineering education to a select group of five universities and nine corporations. Other studies which utilize different sampling frames could further explore the nature of collaboration in continuing engineering education. Such research could probe and test the findings of this study. Three factors to consider in the design of future studies of collaboration include the profession(s) to be studied, the selection of the conceptual framework guiding the research, and the setting(s) in which the collaboration occurs.

The continuing engineering education programs in this research reflected a range of engineering disciplines designed for engineers with various educational needs. These included both credit and non-credit programs for electrical engineers, computer scientists, mechanical engineers, and aerospace engineers. Also, programs were designed for engineers at varying points in their professional careers; some were pursuing additional technical knowledge and expertise while others were engaged in programs to advance their careers in management.

A different study of collaboration in continuing engineering education could focus upon a single engineering discipline. Another could compare and contrast activities across a group of engineering disciplines. Other studies could analyze collaborative efforts for engineers with varying lends of education at various points in their professional careers. Examples include the engineer with a bachelor s degree and five years of experience; the engineer working in a technical unit with a master's degree and ten years of experience; the master's prepared engineer with 20 years of experience working in management; and so on. Other studies of collaboration could analyze similarities and differences across professions; for example the collaborative continuing education practices in law, medicine and engineering.

The conceptual framework of this study drew upon Allison's seminal work in organizational decision-making. The three models of decision-making that he outlined (rational, bureaucratic, and political) influenced the selection of the research questions, the interview schedule and data analysis. Allison suggested (p. 259) that the best analysts weave the strands of each of the three conceptual models in their analysis. The findings of this research suggest that the strands can consist of varying weights or density. That is, in the design and implementation of collaborative continuing engineering education programs, the rational, bureaucratic, and political models may not be equally weighted. In certain situations, for example, the political model may dominate. Thus when a chief academic officer noted that a collaborative continuing engineering education program was a political decision, he did not necessarily mean to suggest that rational and bureaucratic decisions didn't influence the activity. But in that instance, perhaps, the political model dominated the rational and bureaucratic models of decision-making.

The setting in which the collaboration occurs represents a third variable that could be manipulated to yield other research projects. This study focused on research universities and their corresponding relationships with nine large corporations. Studies could be developed to explore collaboration in other institutions of higher education, such as teaching colleges, comprehensive universities, or community colleges. Additionally, aspects such as size of institution, status as public or private, and geographic location could be factored into the research design. In regard to the corporations under study, collaboration in continuing engineering education could be focused by industry and by company type, size or location. Studies which examine collaborative programs in other countries could further enrich understanding of this topic. This study utilized a qualitative research design which yielded rich descriptions of collaborative activities. Analysis of these descriptions produced useful generalizations about collaboration in continuing engineering education among research universities. Quantitative studies could be helpful in analyzing collaborative activities among a larger sample of institutions.

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Education-Business Partnerships: A Principal's Perspective

IRENE DIEDRICH-RIELLY

In 1983, President Reagan declared the "year of partnerships in education" and urged business and education leaders to attend to their important and solemn obligation to provide leadership in the education of our young. In providing leadership we must always draw upon those many elements of our society which have much to contribute--the worlds of business, technology, the arts, the social sciences--while remembering that our mission is to serve the learner.

Clearly, our children must be better prepared for the workforce. However, that's only a piece of a much larger picture, a picture that we must always see without condemning others for not seeing. Business and education's interests intersect in certain areas. They do not duplicate.

It's been a very enlightening experience for me to hear the speakers these two days bring out many points which emerged repeatedly in my own small study of a few years ago. Successful collaboration occurs in areas of clearly defined common ground. The sharing of resources between business and schools promotes the expansion of resources for both.

The projects and programs described in this symposium illustrate the great success that can occur in finding both the broad and the discrete areas of overlap between business interests and educational goals. At the same time, it has to be remembered that we are not one in the same.

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Successful collaboration is open to influence. Heightened awareness between educators and the business world provides a personal growth experience for everyone involved. This involvement affects our beliefs as well as our behaviors, as illustrated by the Massachusetts Teacher Education Program. Through this program, future teachers are given a broader view of what this world is about without indoctrinating them or causing them to see themselves as agents of business and preparing workers. Their integrity as educators is maintained while at the same time their world is enlarged.

Third, the little things matter. In any partnership, recognition, follow-through, attention to the dreary details are all critical factors in the ultimate success of any project and its outcomes for students.

Another important area to emphasize is developing a clear and narrow focus in specific programs. In the past several years, the Boston Compact has been prominent in the literature. In essence, this mammoth consortium involving all of the schools, several universities, and most of the major businesses, had taken over the Boston schools. When the efforts were examined a few years later, the decline in the schools had continued. The dropout rate was increased, not reduced. In contrast, the Corridor Partnership, with a mission focused on improving education in science, mathematics, and technology, suggests that zeroing in on a particular goal and pursuing it on an extended basis is very important.

Finally, we all need to remember that educational leaders are and must always be entrepreneurs. The California Partnership Academies points out something for us to consider, particularly in regard to vocational education. By carefully blending content and application, perhaps educators can exercise further leadership in breaking out of that old "one best way to do the job" mentality that was established in our schools over 50 years ago. As noted in the Motorola program, when all students come under the umbrella of vocational education it will be a revitalizing force in our schools.

The major challenge for all of us in the years ahead is to develop and implement programs which are fully informed by a thorough understanding of the many facets of the world around us, but always determined by our professional abilities and our commitment as educators to the youth we serve.

Public-Private Secton Collaboration: Elements, Issues and Implications

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This Symposium and the set of papers presented herein have examined several diverse collaborative efforts designed to improve education and training programs through substantive involvement of the private sector. While the range of programs examined has been broad, ranging from secondary vocational education to teacher education to continuing professional education for engineers, there are a number of common elements found in these collaborations. These shared characteristics and the success achieved by the various collaborations hold major significance for future training of educators and administrators. Additionally, implications can be found for focusing public policy, charting needed research and evaluation studies, and providing leadership for broadening the "collaboration" among the U.S. business and education enterprises.

This concluding chapter has two purposes. First, the "common elements" of the collaboratives discussed in the papers will be explored in relation to the current literature on successful partnerships. To date, much of the literature focuses on education-business partnerships of a particular type (e.g. adopt-a-school) or a particular level (e.g. community colleges). This analysis of common elements extends the frame of reference for the field beyond single focus partnerships. Second, the major implications for extending and improving future collaborative endeavors affecting education will be

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examined. More specifically, directions will be suggested for research and evaluation, teacher education, and leadership.

Elements of Successful Collaboration

Throughout the papers there is repeated mention of several elements of successful collaboration. The National Alliance of Business (1987) and other groups have examined existing education-business partnerships and posited what they consider to be the key elements or components of an effective collaborative endeavor. Most of the work undertaken by the National Alliance of Business (NAB) has focused on describing ways in which business leaders can and should get involved in local educational improvement efforts. Over the past three years the NAB has conducted The Compact Project: School-Business Partnerships for Improving Education. Twelve major cities have participated in the project by developing written agreements (i.e. compacts) focusing upon improving urban educational systems. This project was designed to build upon the experiences of the Boston Compact initiative. The following principles and recommendations are drawn from the work of the Compact Project:

1. If partnerships are to achieve their maximum potential, it is important to coalesce committed, high level leadership from many organizations and sectors. While one leader's energies and organizational skills are helpful, a broader coalition is imperative if significant changes are to be made.
2. It is imperative that all partners make a commitment to be involved for the long term.
3. It is essential that all partnership members understand and articulate a shared vision of what the changes should be. There is no place for separate agendas. Indeed, openness to to a redefinition of roles is imperative.
4. Partnerships are most effective when all who are involved develop, agree upon, and regularly measure long- and short-term goals and objectives. Student, staff, administrative and system progress should be measured--not just test scores, the number of jobs filled, and other objective data.
5. It is important to establish an organization to manage day-to-day efforts and measure progress against pre-determined objectives. Existing organizations (e.g. local Chamber of Commerce) or a new organization can be used for this purpose (National Alliance of Business, 1989, v-vi).

While the public concern has not been as acute, increased education-business collaboration initiative has also been touted as important in higher education circles. As more technology intensive jobs have emerged, the demands for workers with more sophisticated skills has increased. Additionally, the need to provide skilled workers in many technical fields (engineering, computer science, allied health fields, etc.) is seen as increasingly important to economic growth and development in particular states and regions of the nation. Community colleges and four-year colleges and universities are called upon to work closely with state and local governments and business organizations to participate actively in economic development, work force retraining, and customized training programs.

A survey study conducted in 1986 by the Stanford Research Institute and the American Association of State Colleges and Universities examined the involvement of 300 colleges and universities in economic development efforts. Respondents identified the following factors as highly related to successful partnerships:

1. Entrepreneurial leadership
2. A clear mission
3. Well-defined and understood community needs
4. Institutional capacity (to deliver quality programs and services which fulfill specified needs.)
5. Strategic location
6. Effective relations with the public and private sectors
7. Availability of resources
8. Supportive culture
9. Supportive policies
10. Facilitative organizational arrangements. (Chimura, 1986).

As one examines these two lists of critical elements there are some distinct commonalities as well as some clear differences. The common elements focus on assuring high level leadership involvement from public and private sector collaborators, developing a clearly stated and shared vision, and the need for new organizational arrangements which serve to facilitate the collaborative process and manage the new endeavor. The literature examining K-12 school-business collaboration is clearly more focussed on education and long term relationships than the literature on higher education-business collaborations which emphasize short-term training. The school level collaborations also appear to emphasize evaluation and the use of evaluation results to make institutional changes in curriculum, policies, and instruction. On the other hand, the studies of higher education-business partnerships stressed the importance of entrepreneurial leadership and finding the assurance that appropriate institutional capacity exists prior to launching into programs which respond to industry based needs for training or research.

The six papers presented herein reinforce much of the wisdom acquired from previous studies of private/public sector collaboration in education. They also contribute some additional insights regarding the essential elements for effective cooperation, and offer some special nuances as well.

The papers by Grubb, Digate and Bollendorf, Colgan, and Bush note the critical need for initiation and intensive involvement in these efforts by high level policymakers, education leaders, and business leaders. As Digate and Bollendorf note, often the initial steps have been taken by charismatic and insightful individuals from the business community. Each of the papers reinforces the view that commitment and sustained relationship of a group of individuals who head up the partnering organizations is essential. Professor Grubb's paper calls for participation by governors and federal officials in shaping economic policies that minimize "smoke stack chasing" among neighboring states. He suggests more cooperative approaches to economic development are needed, and should be embraced by government, education and business leaders.

The partnership endeavors presented at the Symposium were selected, in part, based on their longevity. Three of the papers (Bush, Digate and Bollendorf, and Maloy et. al.) expressed clearly the need for endurance and persistence in shaping these evolving relationships. Clearly, it takes time for the business community to understand the values, complexities, and cultures of the schools and higher education and vice versa. The most successful collaborative programs with an education focus (as opposed to a training focus) appear to be shaped over periods of three to seven years.

The presence of a shared vision which is based on clearly recognized educational and employment needs was discernible in many of the papers. Jacobs discussed the role of the Liaison Office in working with employers, community college administrators, union leaders, and professional and trade organizations to develop education and training programs which all parties agree is needed for the new manufacturing industry. The shared vision described by Bush focused on the integration of math, science and English skills using contemporary career skills (e.g. electronics, computers) as vehicles for serving drop-out prone, at-risk high school students. These visions take various forms, but each partnership seems to have one or more distinct mission clearly in view.

There is some support found in the papers for the creation of new organizational units. Entities and newly created organizations such as the Liaison Office (Jacobs), the Electronics Academy within San Jose high schools (Bush), the Corridor Partnership for Excellence in Education (Digate and Bollendorf), and Planning Board (Maloy, et al) are acknowledged for being able to provide a "common ground" for new ventures. These arrangements establish new and somewhat novel mechanisms for addressing pressing problems that often have been dealt with ineffectively by the existing institutional system. Also, they appear to provide for goal setting and accountability. Administrators and staff of these new units are provided with clear understandings of the target outcomes and often feel compelled to assure that their program is successful because they are "in the spotlight."

The commitment to doing and using evaluation in shaping the directions for education-business collaborations is evident in several of the papers. The Peninsula Academies Program in California (Bush) attributes much of its success in acquiring basic state funding and in developing replications of the model program in other communities to a rigorous commitment to evaluation. By using comparison groups and student level data, they have been able to demonstrate the impact of the program on reducing the dropout rate and enhancing student's basic skills. The MESTEP program (Maloy, et al) used comments and field logs from their students who were preparing to be teachers to understand more clearly how they viewed: teaching and learning processes, the value of the "real world" context in learning, and the development of their personal skills and professional competencies. Grubb argues convincingly for viewing these new collaborations as "working experiments" that will aid us in improving educational and social policy.

Discussion

Over the past decade the privatization and private sector movement in the public arena has produced a plethora of educational initiatives. The Reagan presidency focused heavily upon limiting public expenditures through increased volunteerism and private sector involvement in social issues. Renewed interests in private and parochial schools and enhanced parental "choice" of public school attendance locations in several states and communities continue to be central topics of interest.

From this genesis, a diverse array of other collaborative efforts have emerged or been renewed as well. Several of the recent curricular proposals for high school reform (e.g. Boyer, 1986; National Commission on Secondary Vocational Education, 1984) have called for students to engage in learning in non-school settings through public service and cooperative work experiences. Such a thrust recalls some of the earlier initiatives of career, vocational, and special education to provide cooperative, supervised work experiences as an integral part of the curriculum. During the period of 1983-84 and 1987-88, Heaviside and Farris (February, 1989) report that the number of education partnerships between elementary and secondary schools and community/business organizations grew from 42,000 to 140,800. During this period the rate of participation in partnerships grew from 17 percent of the schools to 40 percent, directly involving more than nine million (24 percent) students. In this study, principals reported a wide variety of business support to schools, including providing guest speakers or demonstrations; donating computers, books, or other equipment; contributing employees as teachers; providing grants to teachers and staff development opportunities; tutoring special needs students; providing special awards for teachers, students, or schools; and use of partner's facilities. The NAB (1987) reviewed partnerships between the education and business communities and classified the activities as even broader in scope. The NAB partnership matrix notes six levels of partnership: policy (e.g. lobbying, publishing policy statements), systemic educational improvement (e.g. forming compacts, development of model demonstration programs), management (e.g. providing management support and business services), professional development (e.g. on-site consultation to teachers), classroom (e.g. student mentoring programs), and special services (e.g. sponsoring career fairs).

Implications for Research and Evaluation

From this diverse set of education-business collaborations, the most critical and central research and evaluation needs are twofold. First, efforts should be undertaken to develop conceptual frameworks for classifying these endeavors. Conceptual schema such as the one provided by the NAB offer helpful beginnings. However, for evaluative purposes such schema should seek to identify collaborative endeavors on the basis of educational outcomes. If one more clearly understood what learner and education-related outcomes were intended by the partnership, evaluative questions could be examined more fully. If, for instance, the partnership endeavors were focused on helping to reduce the dropout rate among at-risk students, services and interventions would be more clearly targeted and the impact of certain services in producing the specified outcomes could be examined systematically. As the papers presented herein indicate, evaluation efforts for new partnerships have often been done on a piecemeal or ex-post facto basis. Many of the efforts have focused on marshaling new resources for the schools and bringing fresh perspectives to experiential learning or the needs of business and industry. The nature and extent of the impact of many of the efforts to date has been difficult to ascertain. Focused, critical evaluations will enable these efforts to move forward in addressing complex educational questions.

Second, as these partnerships change the educational and learning environment, a host of interesting and provocative research questions are raised. Here again, the need for developing frameworks to guide this research is imperative. Many of the collaboratives were formed to tackle seriously such problems as dropping out of school and enhancing students' basic skills. When treated as a research experiment or study, these interventions offer invaluable opportunities to develop new knowledge and understandings about these educational problems and the effectiveness of different approaches in dealing with them. In studying the implementation of the California Partnership Academies, Dayton and his colleagues (1987) have found, for instance, that: (a) Academy students' attitudes toward school and self-esteem improved significantly based on pre/post program measures, (b) the mean attendance rate increased to 90.5%, up from 83% in 1984-85, and (c) the mean number of credits earned and the grade point average of Academy students improved. Carefully designed and long term studies can accurately document the effects of collaborative programs, and perhaps more importantly, provide a basis for altering institutional policies and practices conducted by schools, postsecondary education institutions, and employers.

In addition to issues directly concerning the effects of new collaborative endeavors in achieving desired student outcomes, there are a host of other important questions. Research and evaluation studies are needed which examine: the nature and extent of institutional change found within partnering organizations, the efficacy of new, third party organizations, and the impact of the education-business collaborative movement in the larger arena of public school reform. Some states, such as Wisconsin, have made education-business partnerships a central aspect of the statewide school improvement initiative. On a national level, the reports by the Committee for Economic Development (1985) argued strongly that business involvement in school reform was essential.

Implications for Teacher and Administrator Education

The Maloy et. al. paper describes an excellent teacher education program which is predicated on the principle of corporate-university-school collaboration. The efforts of the University of Massachusetts in establishing this program which prepares liberal arts and science graduates to be science, English, and mathematics instructors for the schools merits close review by the teacher education community. The use of extensive clinical and field experiences in the corporate education and training world and public school settings assures that teachers will emerge from the program with a much broader professional context than students in traditional teacher education programs.

As professional education programs for school personnel are revised, careful consideration should be given to coursework which deals explicitly with education-business collaboration on a variety of levels, including curriculum, instruction, supervision, teacher improvement, and administration. Traditional courses dealing with the use of business and community advisory committees and school-community relations must be re-vitalized to reflect the broad array of collaborations reflected in the papers presented herein.

University-based teacher and administrator education programs should seek to place their students for clinical experiences in schools where new, experimental school-business collaborations exist. Additionally, local representatives of these partnerships (from both the business and school side) would make excellent resource presenters in undergraduate and graduate courses. Future teachers and administrators must exit their programs with a much clearer and comprehensive understanding of how the education and business communities can interact to produce graduates with the expertise needed to be competent citizen-workers in the 21st century.

Implications for Leadership

Leadership needs to take place at two levels: within the organization and across organizations. A common theme throughout these papers is how these programs develop in response to a perceived need. These innovative structures are not business-as-usual. Rather, the development of these programs is a testament to the vision, hard work and managerial skills of a number of people. The organization needs to have the self-confidence and flexibility to allow these collaborations to develop.

Leadership is also needed in redefining the relationship between different organizations. Just as education-business collaborations cut across the quite different worlds of public schools, colleges and private businesses, we need more and better examples of how the organizations cooperate. Beyond this, there is considerable uncertainty about the appropriate relationship among a variety of government organizations, including public schools, community colleges, research universities, and state economic development agencies. The traditional boundaries between these organizations do not necessarily apply to these new issues of economic development and collaboration. Leadership is badly needed to extend the limits of these institutions, and to provide by example and policy statement how collaboration can most fruitfully occur.

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